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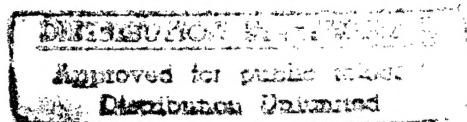


US ARMY  
MATERIEL COMMAND

FINAL REPORT  
OF THE  
GAMMA-RAY LEAKAGE FROM THE ABERDEEN PULSE  
RADIATION FACILITY (APRF) REACTOR

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U.S. ARMY COMBAT SYSTEMS TEST ACTIVITY  
ABERDEEN PROVING GROUND, MD 21005-5059



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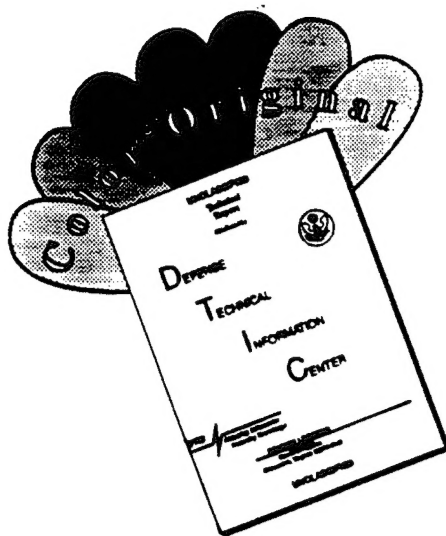
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# Gamma-Ray Leakage from the APRF Reactor

## Craig R. Heimbach

### 1. INTRODUCTION

The Aberdeen Pulse Radiation Facility (APRF) operates a fast-burst reactor in support of its testing programs. The facility is used both in the irradiation of electronics with neutrons and gamma rays to ensure survivability, and as a source of radiation for air-over-ground radiation transport. For each of these uses, a detailed knowledge of the neutron and gamma rays produced by the reactor is essential.

When the reactor is operated, the long-term fission-product inventory is increased. This inventory has accumulated over the years to provide a substantial gamma-ray background even when the reactor is not operating. Backgrounds of a few hundred mRad/hr at 1 meter are typical. These doses are substantial enough to interfere with radiation measurements made near the core.

To perform close-in spectrum measurements, the APRF staff assembled a twin reactor consisting of previously unused fuel. This fuel produced a minimal gamma-ray background of about 3 mRad/hr at 1 meter, allowing neutron and gamma-ray spectra measurements to be made within a few meters of the core. This configuration is called a cold core, or clean core, because of the low background.

Neutron measurements made with the cold core are reported separately<sup>1,2</sup>. The gamma-ray dose measurements are reported here.

### 2. FACILITY DESCRIPTION

The APRF reactor is a highly enriched uranium/molybdenum cylinder which can be made critical without neutron reflectors or moderators. The reactor can be operated in a steady-state or pulse mode. For this test, all operations were steady state.

An attempt was made to keep the cold core as nearly identical as possible to the normal core. The new core, designated 6B, differed from the old core, 5B, in the characteristics listed in Table 1. Most of the changes were made to reduce the background dose rate. The new core diameter was the same as the old.

TABLE 1. MODIFICATIONS MADE IN CHANGING TO NEW CORE

Replaced parts in 6B assembly	
All fuel, including safety block and hanger Cooling shroud B <sub>10</sub> decoupling shield Core support ring Safety tube Rod liners Rod follower Liner hold-down flanges Cooling baffle Safety block centering plate Safety block centering spring Glory hole liner	
6B height	19.1 + 0.63 cm steel plate (7.504 + 1/4 in.)
Regular rod length	25.4 cm (10.0 in.) (unchanged)
Pulse rod length	25.4 cm (10.0 in.) (unchanged)
Mass adjustment rod length	22.8 cm (8.996 in.) (1 in. shorter)
Safety block length	20.5 cm (8.060 in.) (unchanged)
6B core bolts weighed 53 gm more than 5B. 6B total weight was 58 gm more than 5B.	

The reactor was operated inside an aluminum-walled, steel-girder-framed weather silo. The concrete floor of the silo is borated to minimize floor interaction. The reactor may be operated at any height from 60 cm to 12 meters above the floor, and along any one of six tracks. Figure 1 shows the interior of the silo. The reactor and detector are shown in position for a free-field measurement.

For these measurements, two configurations were used. One had the reactor center 5 meters above the floor, with the detectors at the same height. This height was chosen to minimize the effects of radiation interacting with the floor. This geometry is diagrammed in Figure 2, and is called the "free-field" configuration. It should be noted that the reactor transporter, movable detector platform, and silo walls are in some proximity to the experiment.

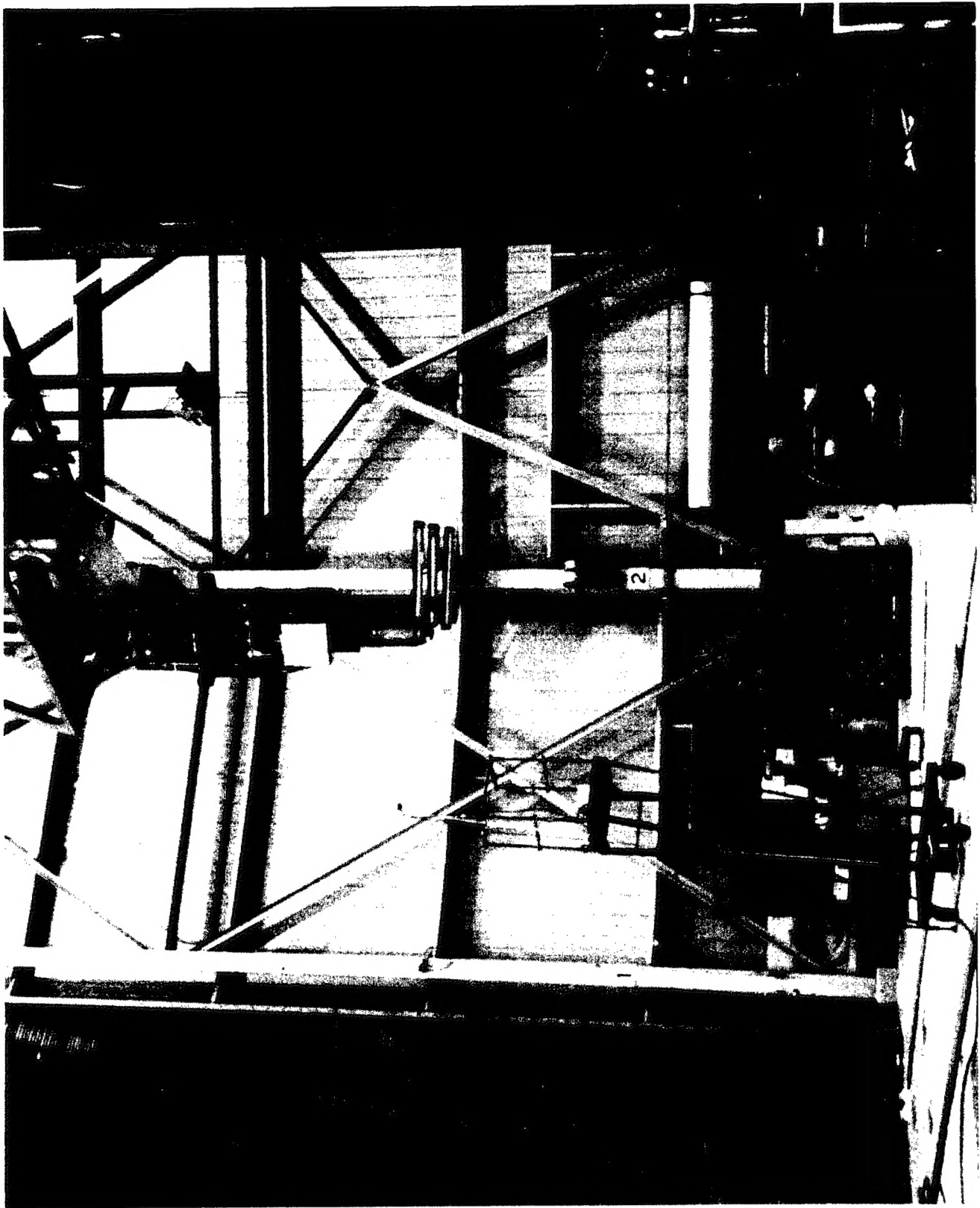


Figure 1. Interior of APRF silo. Reactor is in position for free-field measurement, 5 meters above borated concrete floor.

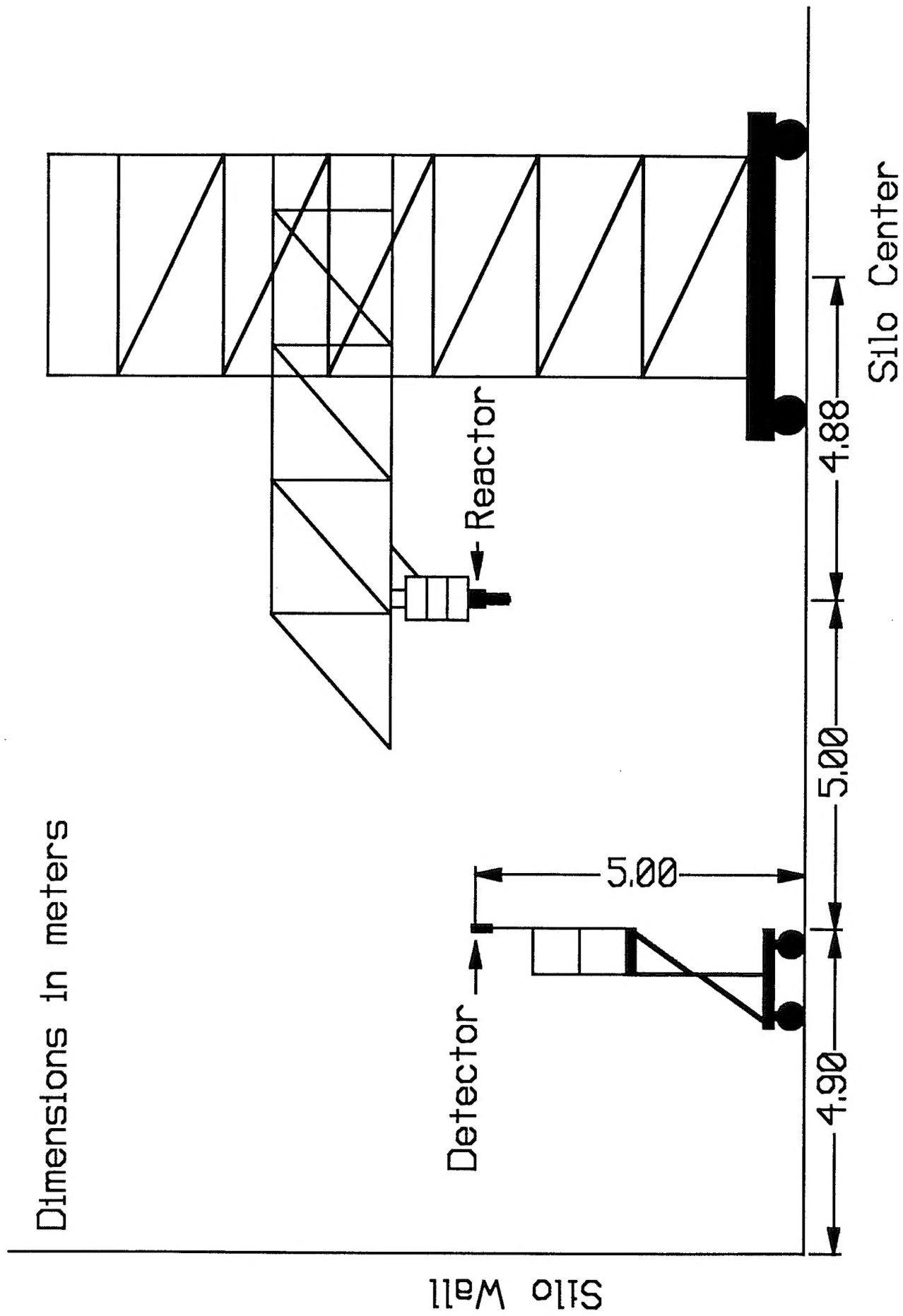


Figure 2. Free-field experimental geometry.

The other configuration had a 10.2-cm (4-in.) thick bismuth shield between the reactor and the detector. This geometry is shown in Figure 3. The bismuth shield attenuates the gamma rays coming from the reactor, allowing measurements to be made closer than was feasible for the free field. This geometry is often used by the APRF to provide a low-gamma-ray environment. As with the free field, measurements could not be made previously because of the background gamma rays.

### 3. EXPERIMENTAL DETAILS

A bismuth germanate (BGO) spectrometer was used for gamma-ray spectral measurements. Its dimensions were 3.8 cm diameter by 3.8 cm thick (1.5 in. by 1.5 in.). This detector was chosen because of its low neutron sensitivity and known response function for gamma rays<sup>3</sup>. The known response function allowed continuous spectra to be unfolded from the data. Spectra were measured out to 12 MeV.

A second detector, a Far-West model GM-1 Geiger counter (GM), was also used to verify free-field dose rates. This counter has an extremely low sensitivity to neutrons<sup>4</sup>. It also has the advantage of low overall sensitivity due to its small active volume. The GM measurements reported here were made with the standard core (5B).

The Geiger counter results reported here include corrections for gamma-ray spectra based on the BGO measurements. This correction lowers the gamma-ray dose 7 percent relative to the Cs-137 calibration factor. There is also a correction for neutron sensitivity which lowers the reported doses by 3 percent relative to a gamma-only field. Dead-time corrections were made, so that the count/s were slightly higher than the counts divided by the time for high count rates.

For all reactor measurements, at least two power levels were used. This was done to ensure independence of the results to power level. At low powers, some of the data were only marginally above background. At high powers, dead time in the detector became a problem for the BGO. In practice, the results proved remarkably consistent.

A complicating factor for the background measurements was the presence of a startup source. This is a PuBe source used to provide neutrons for reactor control when the reactor is assembled. This source actually provided a substantial fraction of the background gamma rays, especially for the bismuth shield measurements. The problem was that the source was exposed to the detector during the background measurements, but not during the reactor runs.

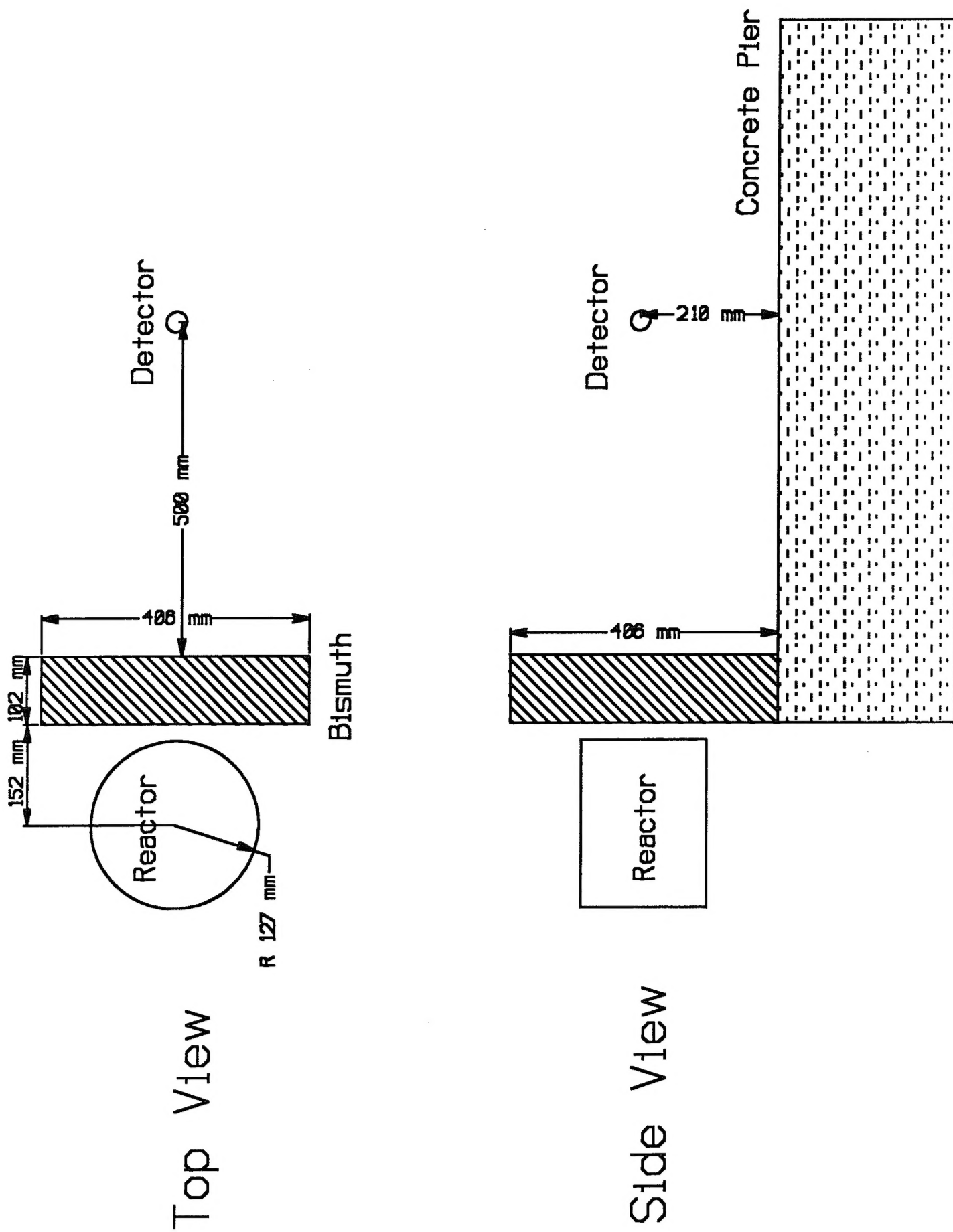


Figure 3. Bismuth shield geometry.

To adjust for this variable background, the background spectra were separated into two components: a portion due to the startup source and the remainder. A pure PuBe gamma-ray spectrum was measured using a spare startup source separated from the reactor. This spectrum was then renormalized to the background magnitude by matching the 4.4 MeV gamma-ray peaks. This normalized spectrum was taken to be the PuBe portion of the background, and it was subtracted from the measured background to determine the residual background. The appropriate background, either the measured background or the residual, was then used, depending on the location of the startup source at the time of measurement.

For the Geiger counter measurements, data were taken at sufficiently high power that this separation was not required.

Appendix A, Tables A-1 and A-2 list the reactor runs used for this experiment.

#### 4. CF-252 CALIBRATION

A practice BGO measurement was made on a Cf-252 source. Although the gamma-ray spectrum of a Cf-252 source is not a standard, this result may be compared to other measurements to validate the technique. Also, should there be any question as to the operation of the detector, this measurement may easily be repeated, but not the cold core measurements. The measured Cf-252 gamma-ray spectrum is listed in Appendix A, Table A-3. The data are listed on a per minute basis. The Cf-252 source was placed between the BGO and the neutron spectrometer. Each detector was 200 cm from the source. The source and detectors were all 108 cm above the borated concrete floor.

Measured Cf-252 gamma-ray spectra are shown in Figure 4. For clarity, the background-subtracted spectrum is shown by itself in Figure 5. The 800 keV gamma-ray background peak is probably Mn-54, due to neutron activation of the iron in the reactor transporter. This measurement was made in the reactor silo, with the reactor in its storage pit.

The spectrum above 10 MeV is not valid because the background is of the same order of magnitude as the data at these energies.

The Cf-252 source strength was  $3.23 \times 10^7$  n/s. Using this and the measured spectrum gives a measured gamma dose rate of  $2.02 \times 10^{-6}$  mRad(tissue, gamma)/n/cm<sup>2</sup>. This may be compared to a National Institute of Standards and Technology (NIST)<sup>5</sup> calibration value of  $1.62 \times 10^{-6}$  mRad(tissue, gamma)/n/cm<sup>2</sup>. The dose measured inside the silo appears to be about 25 percent higher than the NIST calibration. Using an NIST value of  $2.90 \times 10^{-6}$  mRad(tissue,neutron)/n/cm<sup>2</sup> for neutrons gives a N/G tissue dose ratio of 1.4. The gamma-ray emission from a Cf-252 source is not a standard since fission products build up as the source ages. Thus, the neutron-to-gamma ratio decreases as the source ages.

# Cf-252 Gamma Spectra

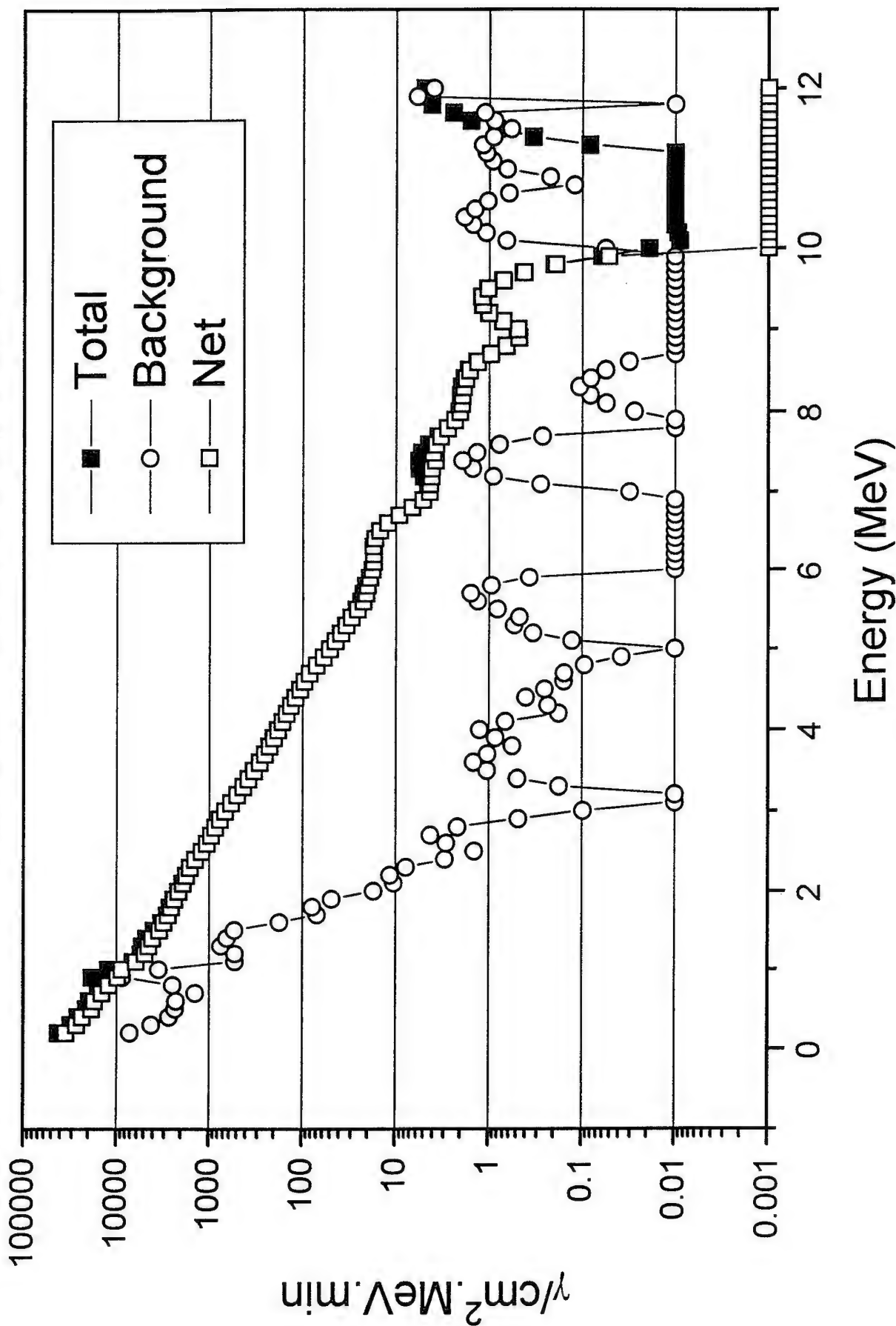


Figure 4. Cf-252 gamma-ray spectra.



# Background-Subtracted Cf-252 Spectrum

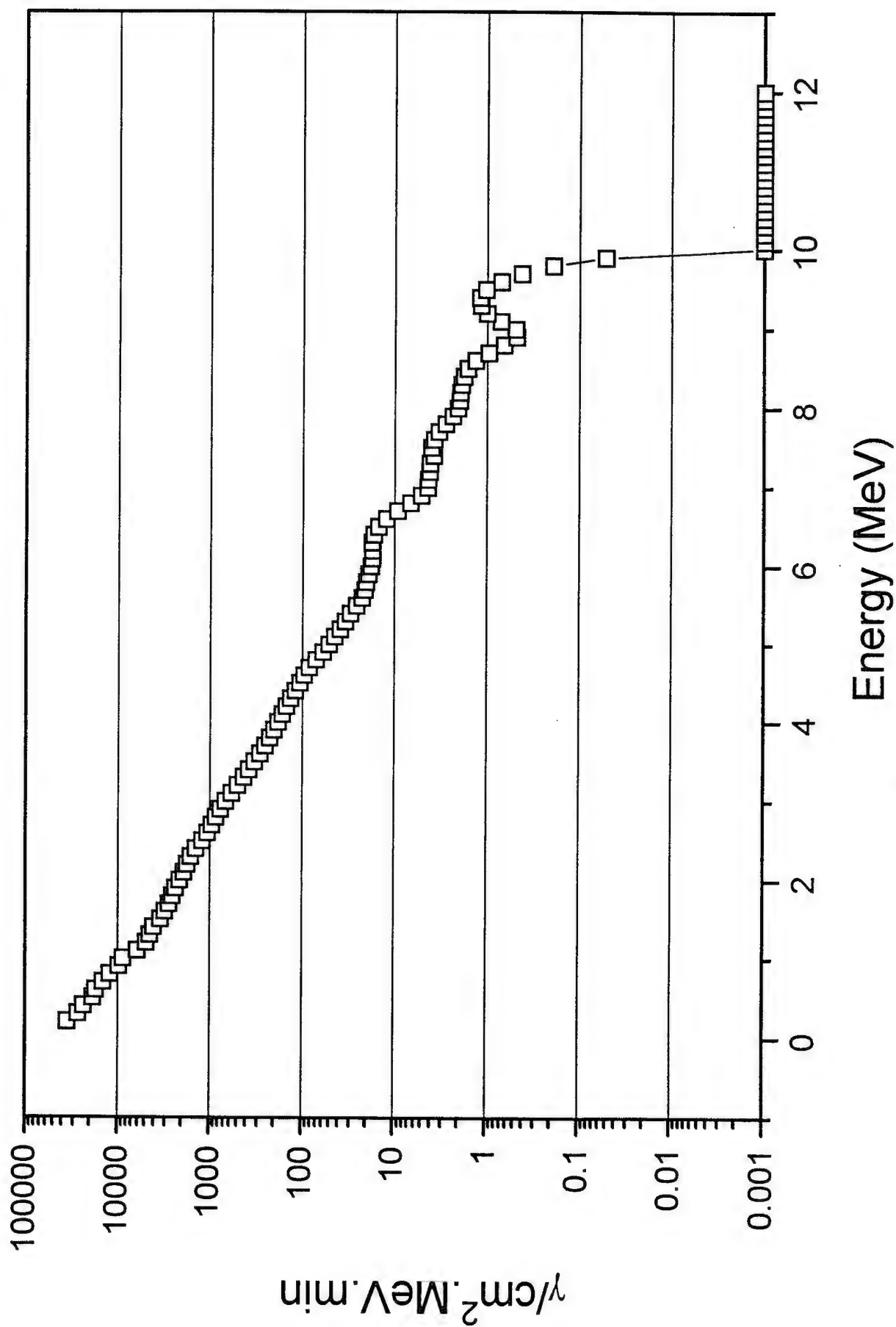


Figure 5. Background-subtracted Cf-252 gamma-ray spectrum.

## 5. FREE-FIELD RESULTS

All free-field gamma-ray spectra, including the startup source, are listed in Appendix A (Tables A-4 to A-6). Two power levels were used at each distance to investigate the effects of dead time on the detector system. Background effects were substantial, so background-subtracted spectra are given as well as corrected spectra.

Background measurements were made with the PuBe startup source present. Figure 6 shows the background spectra for 2 and 5 meters from the reactor. The peak at 4.4 MeV is due to the startup source, which was outside its shield during the background measurements. During all runs except SS94-12 at 0.01 w, the startup source was in its shield. This is the situation for normal reactor operation. To a certain extent, however, moving the startup source changed reactor background.

In an attempt to deal with this, a separate measurement of the gamma-ray spectrum of another PuBe source was made. The PuBe spectrum was normalized to the 4.4 MeV peak in the measured reactor backgrounds, and subtracted. Figures 7 and 8 illustrate this procedure. Most of the high-energy gamma rays in the background were due to the startup source. The residual was taken to be an exponential beyond 4 MeV to avoid oscillations in the background. An alternative procedure of taking the background to be zero above 4 MeV gives virtually identical results in the corrected free-field spectra. The residual spectrum was used for background subtraction when the PuBe source was in its shield; the measured background was used when the source was out of its shield. Figure 9 shows the measured spectrum at 2 meters when each of the backgrounds (the total and the residual) was subtracted. As may be seen from the figure, there is no difference in the corrected spectra except at 4.4 MeV, and even there the difference is small. For the other free-field spectra, the differences were even less than this case.

The measured spectra proved stable with respect to reactor power. For each distance, the highest-power run is taken to be the best because of better statistics. These are shown in Figures 10 and 11 along with an idealized calculated leakage spectrum<sup>6</sup>, where the reactor is surrounded only by air. The peaks above 7 MeV show up in all measured spectra, including the Cf-252 source.

The calculated gamma-ray leakage spectrum does not include gamma rays produced outside the reactor by neutron scattering or absorption events. In the actual experimental situation, neutrons strike the floor, walls, and ceiling of the building, as well as the transporter and the stand that holds the detectors. Fast neutrons undergoing inelastic scattering produce gamma rays in the range of 0.5 to 2 MeV, while slow neutrons produce capture gamma rays that are typically in the range of 6 to 10 MeV. Furthermore, high-energy gamma rays are primarily absorbed in matter by the process of pair production, which ultimately produces 0.511 MeV gamma rays. Some of these extraneous gamma rays are being detected by the spectrometer.

# Cold Core Background Spectra

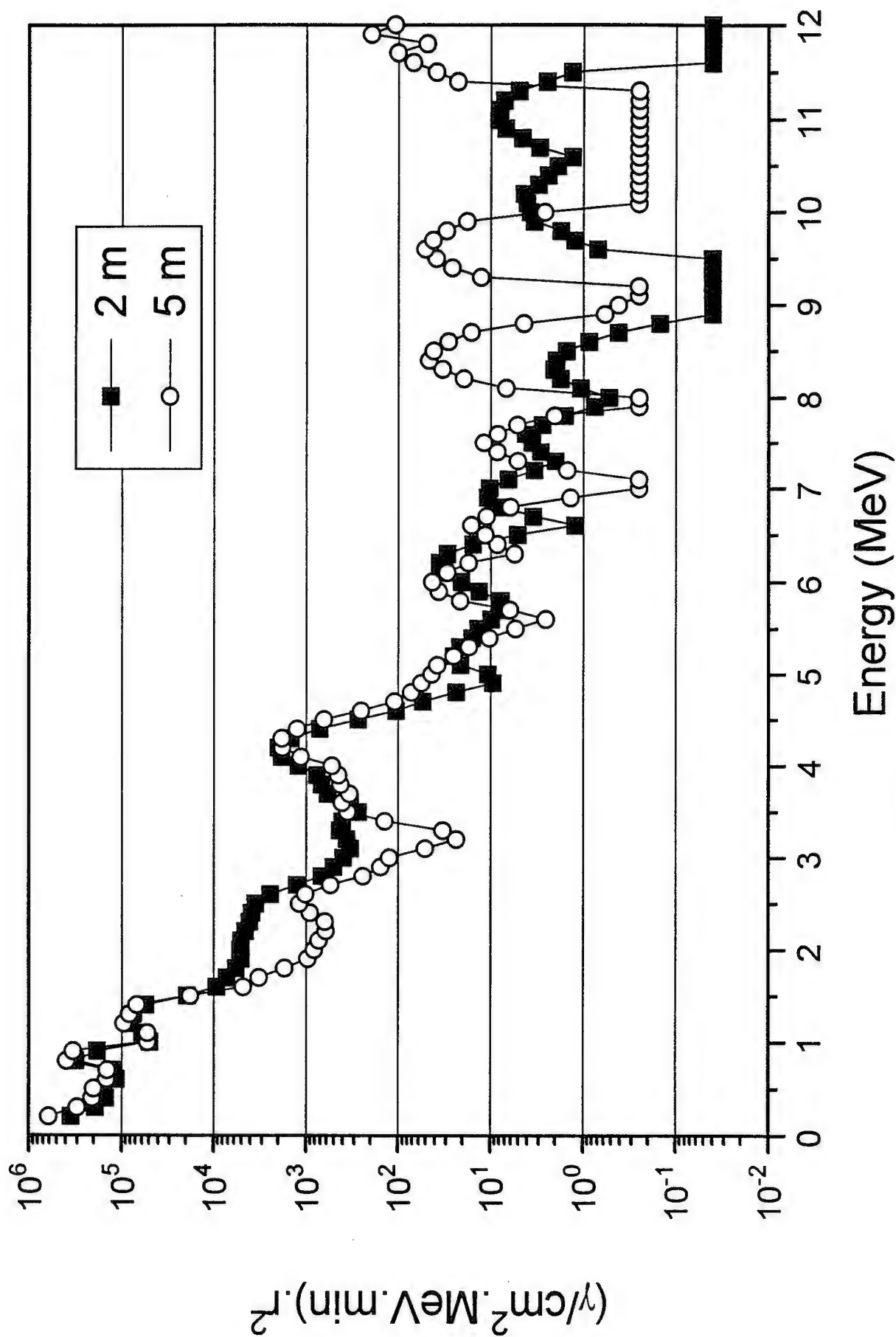


Figure 6. Cold core background spectra, 2 and 5 meters from reactor center.

# 2m Background With and Without PuBe

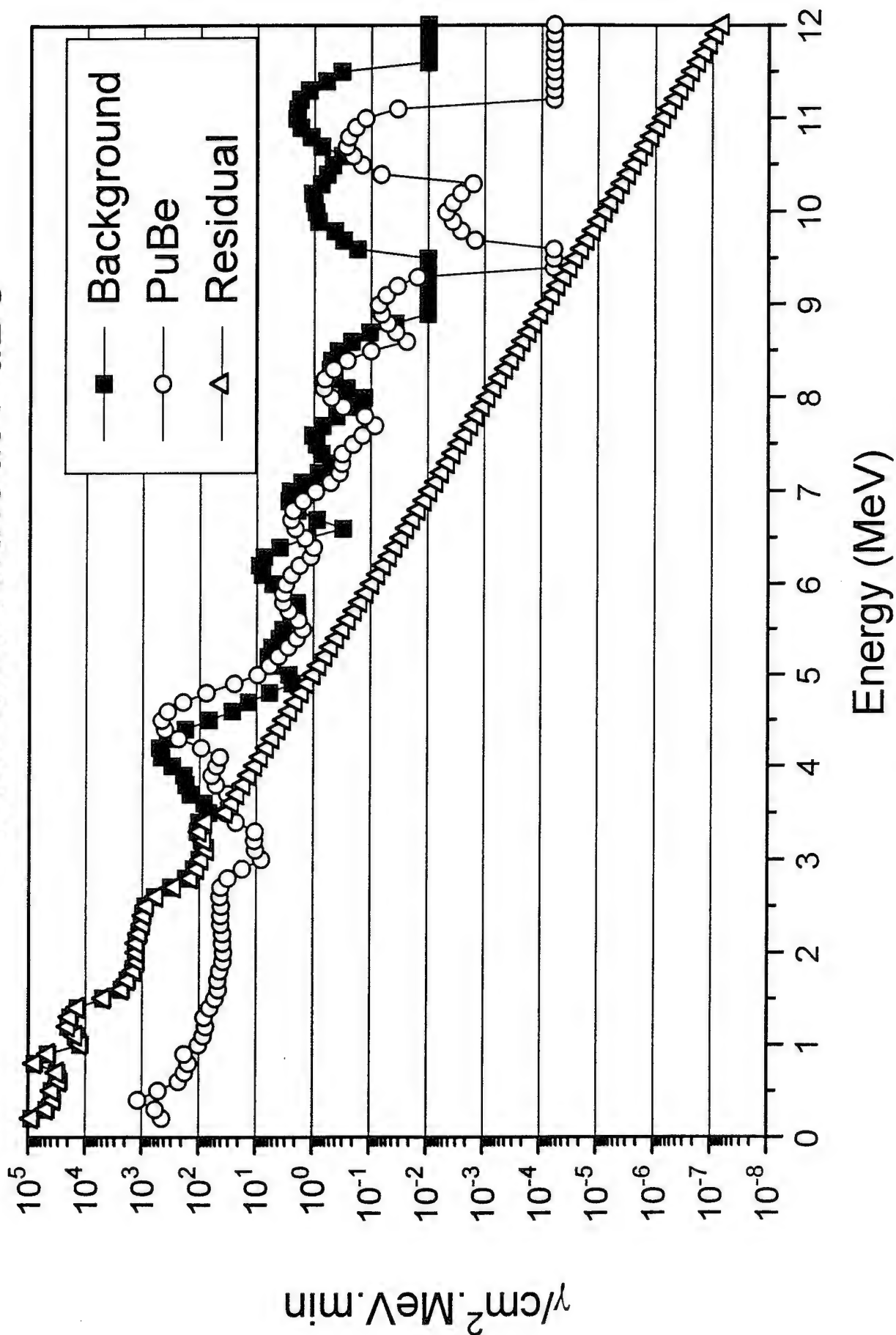


Figure 7. The 2-meter background spectra.

# 5m Background With and Without PuBe

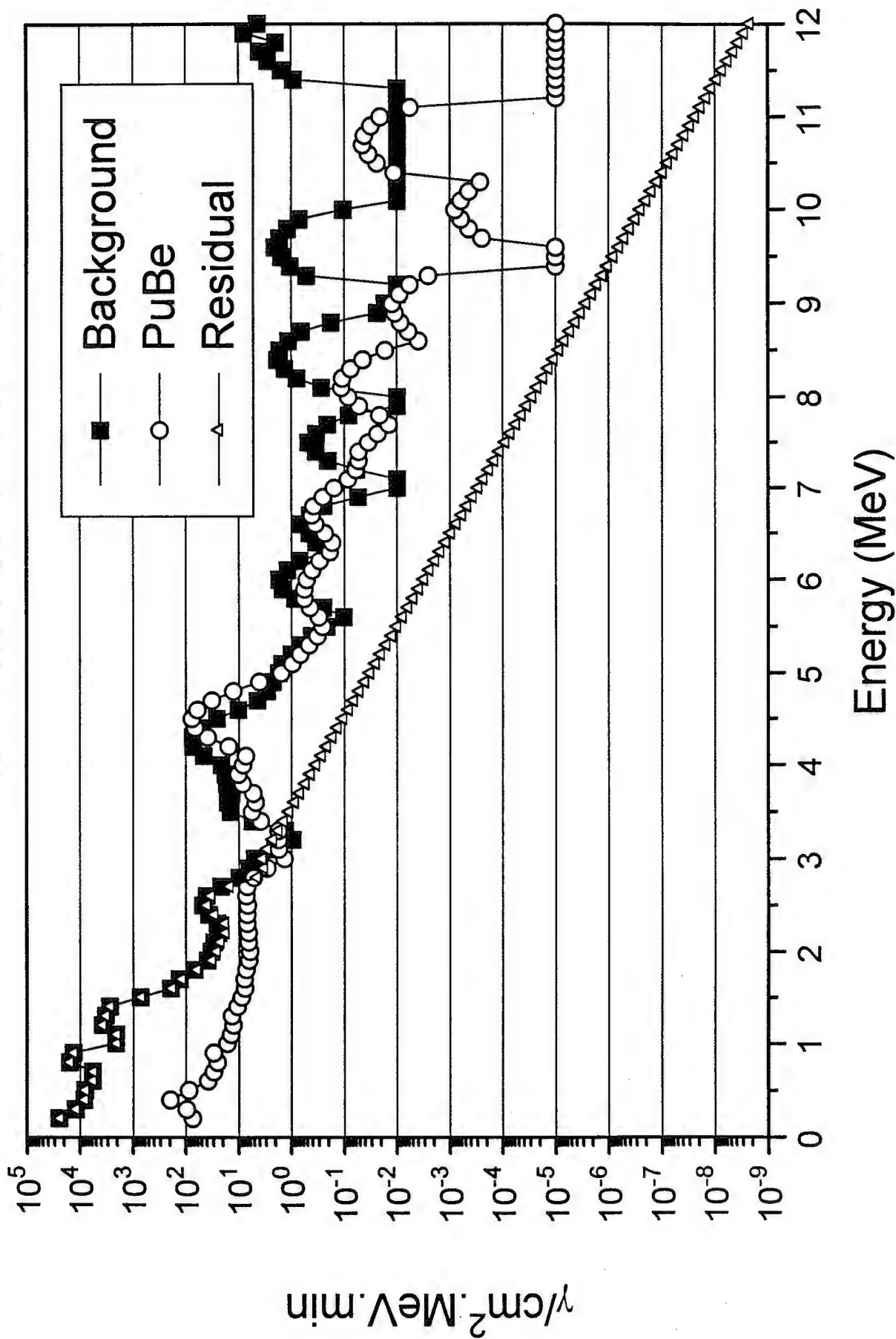


Figure 8, The 5-meter background spectra,

# 2-meter Gamma Spectra

## Raw and background-adjusted

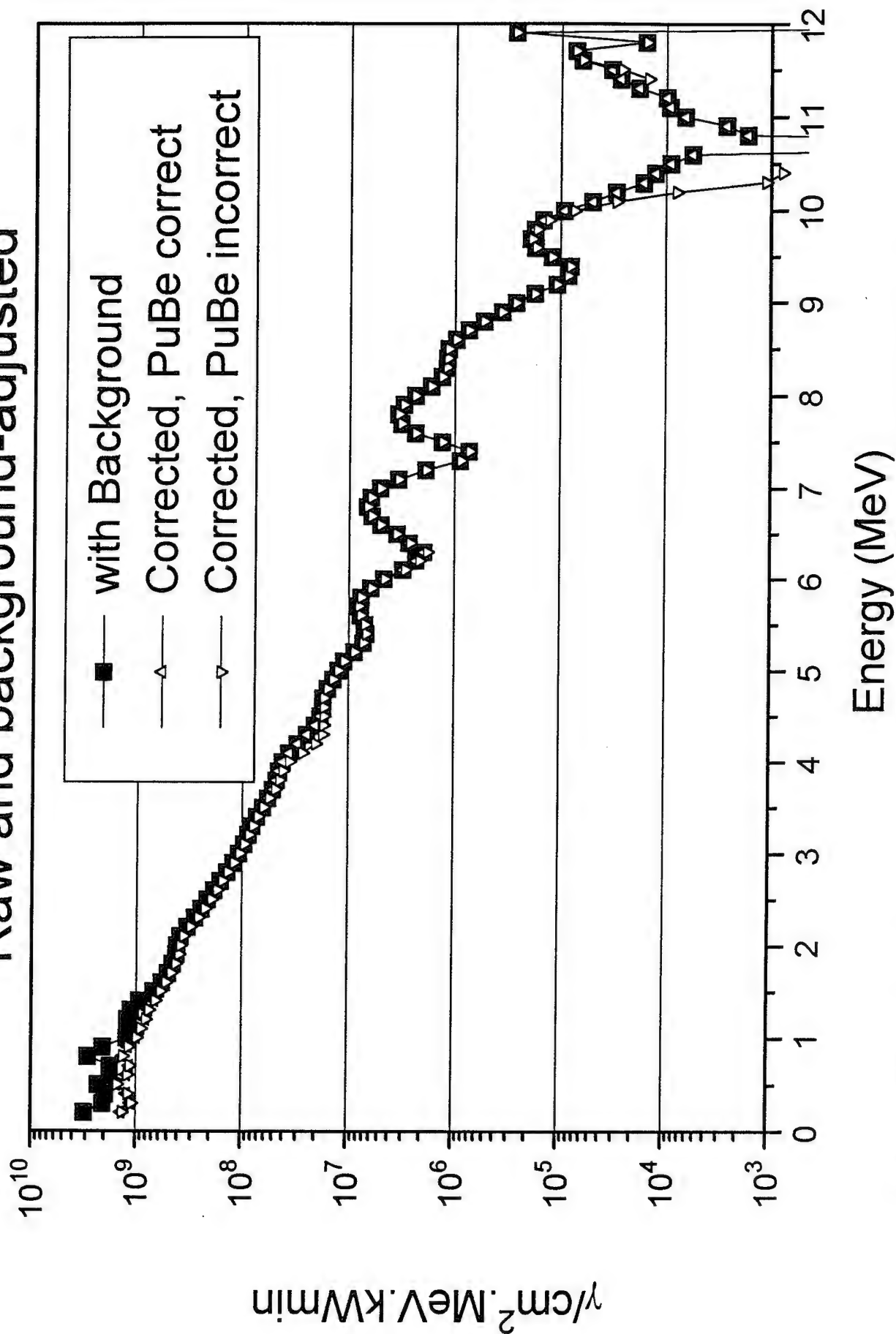


Figure 9. Gamma-ray spectrum as measured at 2 meters from reactor center, raw and with alternative background subtractions.

# Cold Core Gamma Spectra

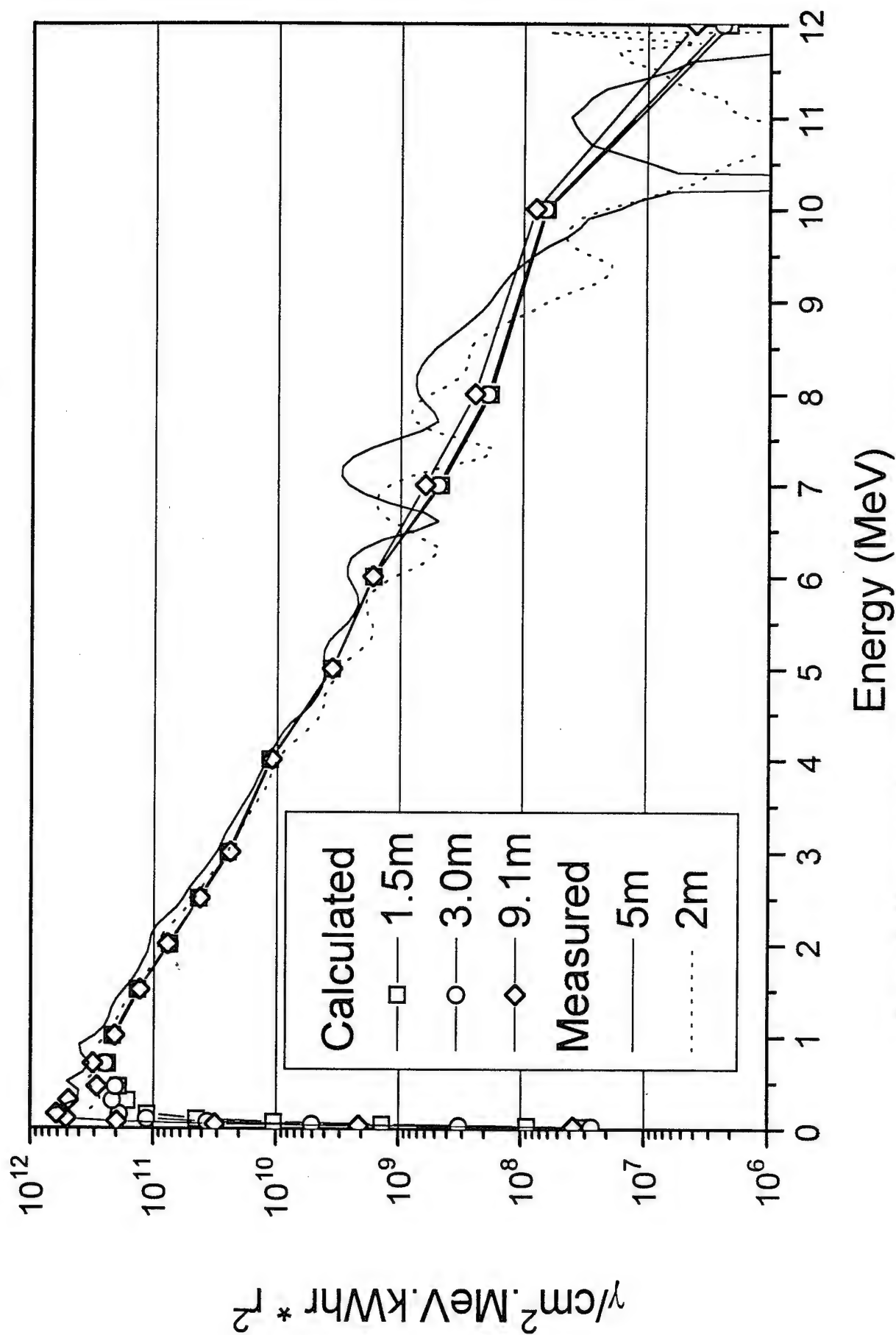


Figure 10. Measured and calculated gamma-ray spectra adjusted for distance, 0 to 12 MeV.

# Cold Core Gamma Spectra

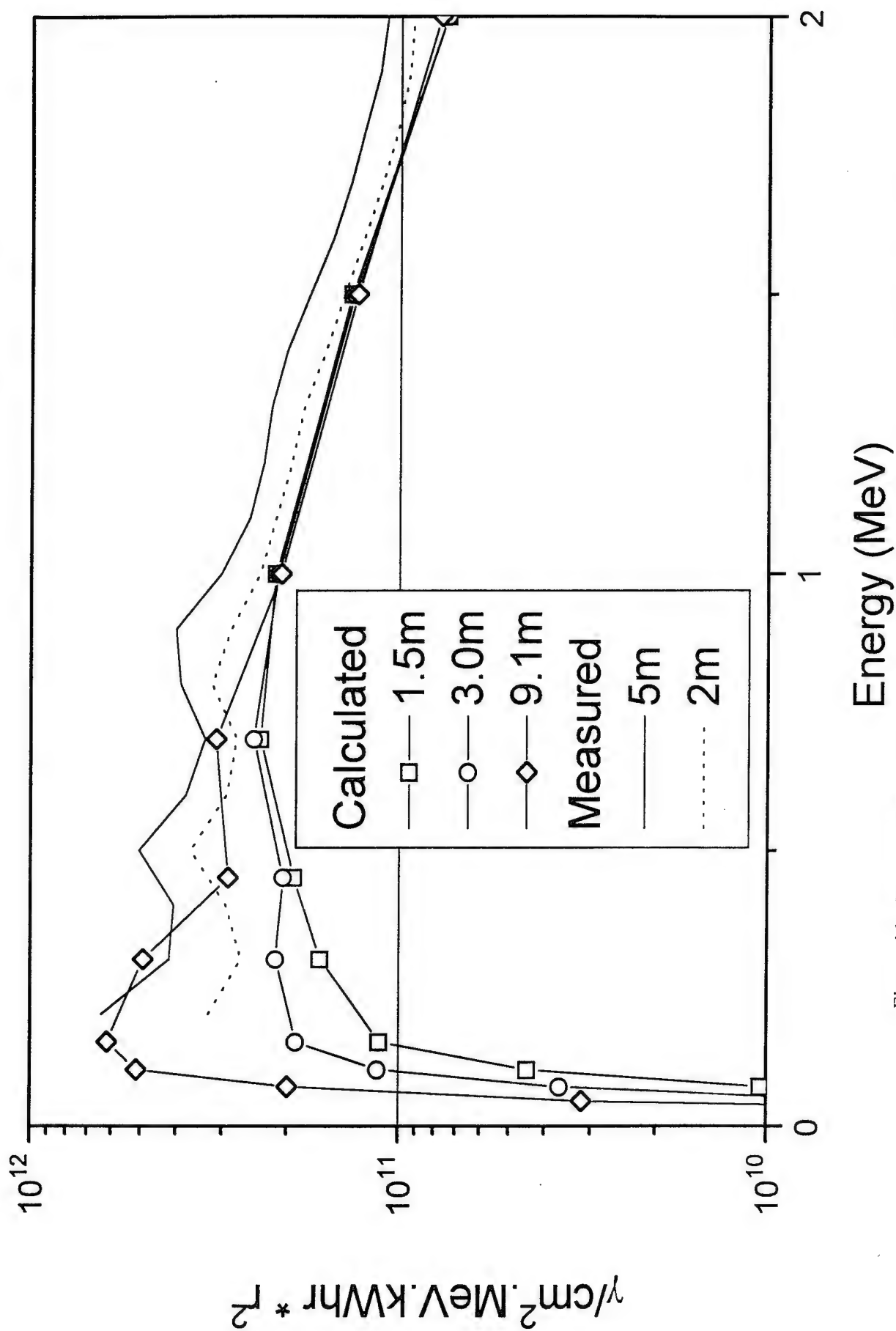


Figure 11. Measured and calculated gamma-ray spectra adjusted for distance, 0 to 2 MeV.



The measured spectra compare well with calculated spectra in shape, but not in magnitude. Table 2 and Figure 12 shows the measured and calculated doses. The measured results are about 50 percent higher than the calculated results. Clearly, some fraction of the measured dose is due to the extraneous gamma ray sources.

TABLE 2. TISSUE DOSE AS DETERMINED WITH VARIOUS TECHNIQUES

	Dose			Dose x Dist <sup>2</sup>		
	Calculation	BGO	GM	Calculation	BGO	GM
Distance, m	Rad(ti,γ)/kWhr			Rad(ti,γ)/kWhr		
0.41			1746.0			296.4
0.91			366.4			304.7
1.52	76.8			177.0		
2.00		60.6	69.5		242.0	277.7
3.05	19.2			179.0		
5.00		12.4	12.2		310.0	305.0
8.19				192.0		342.1
9.14	2.30		5.1			

The data from Table 2 are plotted in Figure 12 in a matter that removes the one-over-radius-squared dependence so that the data should fall on a horizontal line. In comparing dose versus distance, the measured results seem to show a substantial scatter relative to a 1-percent statistical uncertainty, although the GM results and the BGO results are spatially consistent over the region where they overlap. These variations may be due to positioning errors, dead time, neutron effects on the detectors, or to gamma scattering from extraneous materials. There is a clear upward trend with increasing distance from the reactor, which may correlate to increasing relative extraneous dose contributions from the silo floor and walls. There is a clear trend, indicating higher measured than calculated gamma-ray doses in all cases.

Calculated and measured neutron results are listed in Table 3 for completeness. The neutron doses are in much better agreement than the gamma doses. The measured neutron-to-gamma tissue dose ratio ranges from 9 to 11; the calculated ratio ranges from 15 to 18.

# Gamma leakage dose

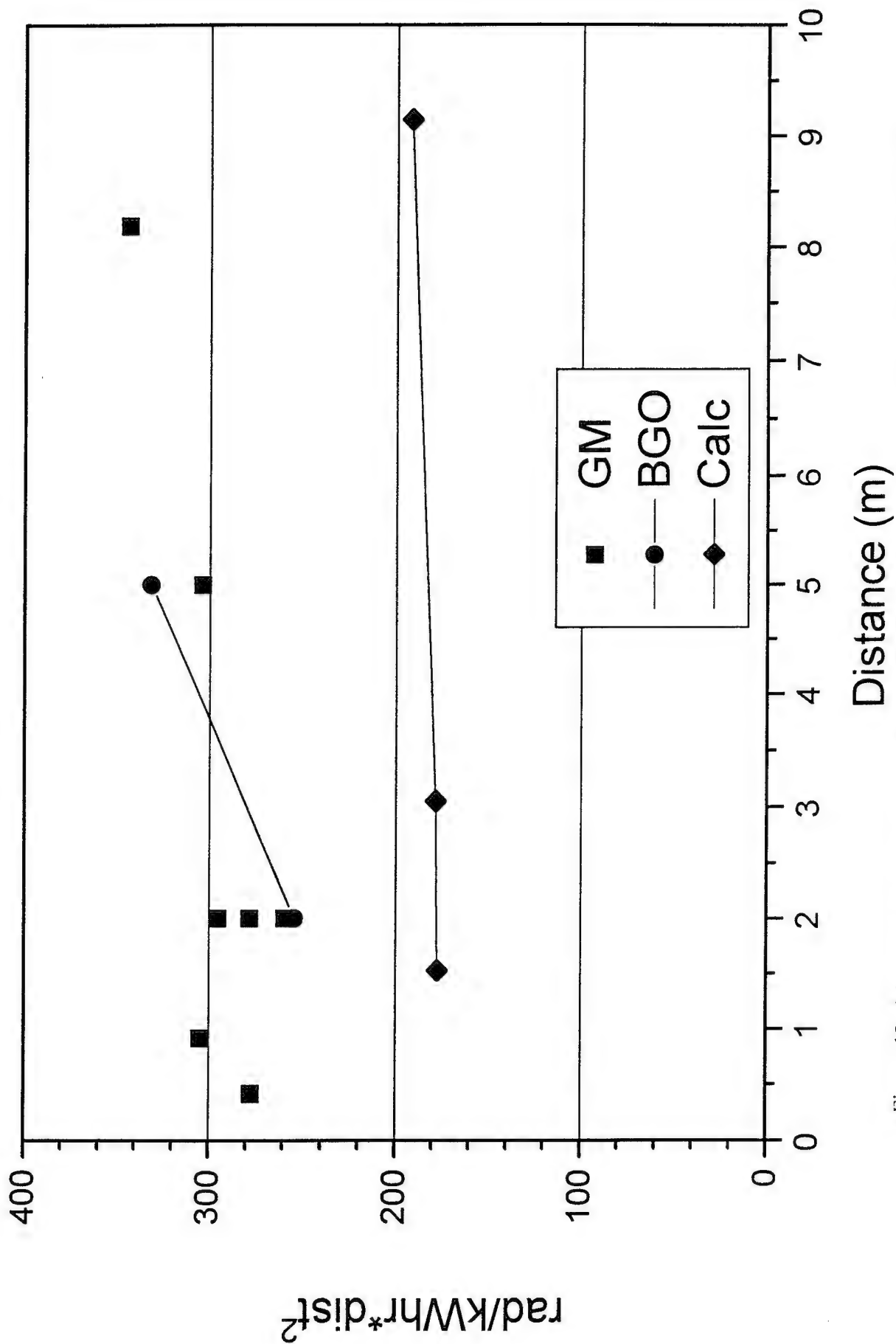


Figure 12. Measured and calculated gamma-ray tissue doses adjusted for distance from the reactor center.

TABLE 3. COMPARISON OF NEUTRON AND GAMMA  
TISSUE DOSES

Free-Field Tissue Doses						
	Measure			Calculated		
	Neutron	Gamma	N/G	Neutron	Gamma	N/G
Distance, m	(Rad/kWhr)			(Rad/kWhr)		
1	2905.0	305.0	9.5	2700.0	175.0	15.0
2	700.0	65.0	10.8	737.0	44.5	16.0
5	137.6	12.3	11.2	132.0	7.4	18.0

## 6. BISMUTH SHIELD RESULTS

The spectra measured behind the bismuth shield are listed in Appendix A, Tables A-7 and A-8, and shown in Figure 13. The oscillations in the low-power runs near 4.4 MeV are due to cancellation of gamma-ray background from the startup PuBe source. The higher-power runs are sufficiently above background that they are more stable.

The bismuth shield is interesting in that the bismuth shielded the detector from the reactor, but not from the startup source, during the background measurement. Thus, the PuBe spectrum contributes relatively more to the background than in the free-field cases. As with the free field, background was separated into two components: a portion due to PuBe, and a portion due to the reactor. The shape of the PuBe component was determined by a separate measurement of a PuBe source, and the magnitude was renormalized to the 4.4 MeV peak. Since the PuBe source was withdrawn during the measurements, only the reactor portion was subtracted from the data.

Comparing these gamma dose results to neutron results obtained with activation foil measurements<sup>7</sup> gives an N/G dose ratio of 30. The N/G ratio may be different immediately behind the bismuth shield.

There are no calculations available for this configuration.

## 7. CONCLUSIONS

Leakage gamma-ray spectra have been measured for a fast-burst reactor. The doses determined from these spectra agree with doses measured with a Geiger counter, but both are higher than the dose calculated for an idealized geometry. Gamma rays produced by neutrons interacting in extraneous materials may account for these differences.

# Gamma Spectra Behind Bismuth

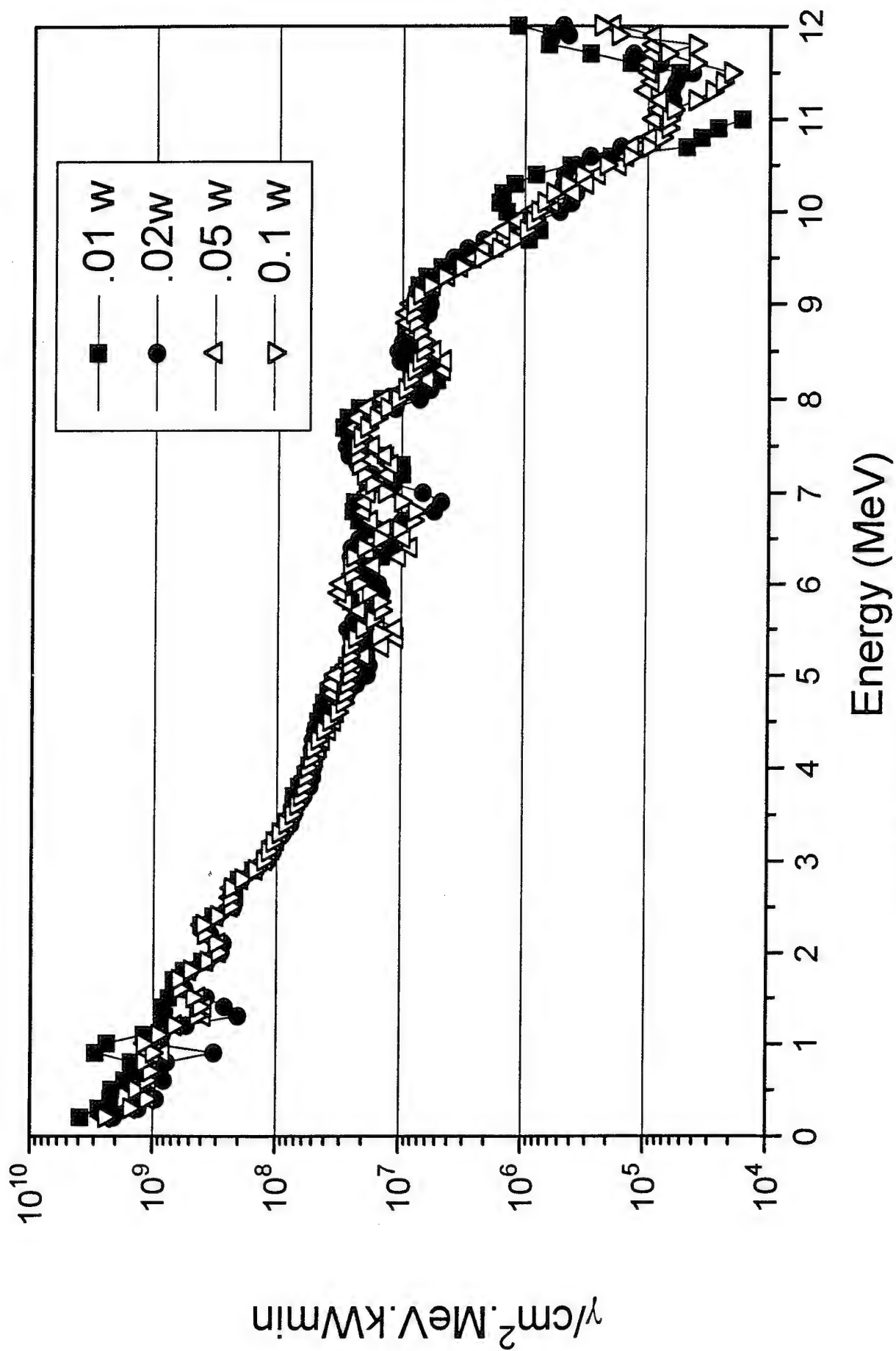


Figure 13. Gamma-ray spectra measured behind bismuth shield.

## APPENDIX A

TABLE A-1. REACTOR RUN SUMMARY

Source	Power (w)	Time (sec)	Dist (cm)	File	Normalize Factor	Na Cal.	Dead Time(%)		Comments
							Hi	Lo	
Na-22		2904	-	Na1241	48.40	158	5	5	
Bkgrnd	0.00	710	500	cc1251	11.75	164	2	1	SB out
Bkgrnd	0.00	878	500	cc1252	14.63	160	2	1	
SS94-11	0.00	908	500	ss11b	15.13	160	2	1	SB in
	0.10	903	500	ss11w1	0.001505	160	5	4	
	0.50	301	500	ss11w5	0.002508	160	20	14	
SS94-12	0.00	913	200	ss12b	15.16	160	5	3	
	0.01	507	200	ss12w1	8.45E-05	160	6	5	
	0.05	397	200	ss12w5	0.000319	160	13	10	
Bkgrnd		62379	-	cc1261	1039.65	160	1	1	On Hijkr
Cf-252		69543	200	cf252	1159.05	160	3	2	
Bkgrnd		927	-	cc1271	15.45	160	1	0	On Floor
Na-22		117	-	27Jna	1.95	169	4	4	
Na-22		174	-	cc211	2.90	169	5	5	Bismuth
SS94-33	0.00	738	75.4	cc212	12.30	169	16	12	
	0.01	600	75.4	cc213	0.000100	169	18	13	
	0.02	847	75.4	cc214	0.000282	169	20	14	
	0.05	819	75.4	cc215	0.000683	169	26	18	
	0.10	626	75.4	cc216	0.001043	169	34	24	
SS94-11 Source shielded for runs.									
SS94-12 Source unshielded for 0.01W, shielded for 0.05 w									
SS94-33 Source shielded for runs.									

TABLE A-2. GEIGER-COUNTER DATA, FREE-FIELD, STANDARD CORE

Geiger counter data.								
Run	Power (w)	Counts	Time (s)	cps	net (cps/w)	Bkgd (cps)	rad/kWhr	error (%)
SS94-175	0.01	11980	300	39.9	216.1	37.77	347.12	0.8
1.00 m	0.05	14051	300	46.8	181.3			
	1.00	80140	400	200.4	162.6			
	2.00	147748	400	369.4	165.8			
SS94-176	0.01	21689	2500	8.7	41.5	8.26	69.54	0.9
2.00 m	0.10	34080	3000	11.4	31.0			
	0.50	42516	1700	25.0	33.5			
	1.00	61894	1500	41.3	33.0			
SS94-177	1.00	3709	500	7.4	6.0	1.40	12.16	0.7
5.00 m	10.00	29402	500	58.8	5.7			
	20.00	58651	500	117.3	5.8			
SS94-178	1.00	1633	500	3.3	2.5	0.72	5.13	0.7
8.19 m	10.00	12461	500	24.9	2.4			
	20.00	24671	500	49.3	2.4			
SS94-179	0.10	10876	500	21.8	28.3	18.92	64.81	0.2
2.00 m	1.00	25023	500	50.0	31.1			
	10.00	16332	50	327.3	30.8			
SS96-89	0.10	33299	200	167.3	185.6	148.7	366.42	1.0
0.912 m	0.50	46744	200	235.4	173.2			
	5.00	199071	200	1026.0	175.4			
SS96-90	0.50	10019	200	50.2	30.6	34.88	74.03	0.8
1.997 m	5.00	42775	200	215.3	36.1			
	20.00	145361	200	743.0	35.4			
SS96-91	0.50	252687	200	1313.2	644.2	991.1	1633.78	2.5
0.412 m	1.00	332091	200	1747.5	756.4			
	5.00	881579	200	5079.6	817.7			
	10.00	1383660	200	8730.3	773.9			

TABLE A-3. MEASURED Cf-252 GAMMA-RAY SPECTRA

Cf-252 gamma-ray spectra.							
Energy (MeV)	Gross	Error	Bkgd	Error	Net	Error	Kerr Ti (Gy/n/cm <sup>2</sup> )
	(γ/cm <sup>2</sup> .MeV.min)						
0.2	4.26e+04	64.9	7197.0	37.4	35373.0	74.9	6.738e-13
0.3	3.11e+04	47.9	4216.0	30.3	26874.0	56.7	1.238e-12
0.4	2.61e+04	41.0	2732.0	30.2	23408.0	50.9	1.810e-12
0.5	2.11e+04	34.4	2351.0	30.8	18699.0	46.2	2.360e-12
0.6	1.97e+04	30.8	2293.0	31.4	17367.0	44.0	2.885e-12
0.7	1.58e+04	25.9	1417.0	32.7	14373.0	41.7	3.378e-12
0.8	1.46e+04	27.3	2481.0	53.6	12079.0	60.2	3.853e-12
0.9	1.84e+04	25.2	8639.0	57.6	9761.0	62.9	4.305e-12
1.0	1.23e+04	16.3	3524.0	33.6	8796.0	37.3	4.735e-12
1.1	6.66e+03	10.4	529.1	17.3	6127.9	20.2	5.136e-12
1.2	5.44e+03	8.94	527.4	19.6	4911.6	21.5	5.508e-12
1.3	5.24e+03	8.03	754.0	19.5	4489.0	21.1	5.880e-12
1.4	4.73e+03	6.93	646.0	17.8	4088.0	19.1	6.252e-12
1.5	3.95e+03	6.18	537.7	13.9	3414.3	15.2	6.624e-12
1.6	3.26e+03	5.84	176.1	7.54	3081.9	9.54	6.962e-12
1.7	2.85e+03	5.69	69.5	6.66	2780.5	8.76	7.266e-12
1.8	2.64e+03	5.61	78.6	6.43	2562.4	8.53	7.570e-12
1.9	2.41e+03	5.52	48.8	4.57	2362.2	7.17	7.874e-12
2.0	2.16e+03	5.49	17.4	3.18	2140.6	6.34	8.178e-12
2.1	1.94e+03	5.25	10.6	3.11	1928.4	6.10	8.464e-12
2.2	1.77e+03	5.01	11.6	2.95	1761.4	5.81	8.731e-12
2.3	1.62e+03	4.78	7.84	2.26	1611.2	5.29	8.998e-12
2.4	1.43e+03	4.52	2.98	1.67	1423.0	4.82	9.265e-12
2.5	1.21e+03	4.27	1.43	1.63	1206.6	4.57	9.532e-12
2.6	1.06e+03	4.08	2.89	1.96	1058.1	4.53	9.799e-12
2.7	9.63e+02	3.90	4.26	1.88	958.6	4.33	1.007e-11
2.8	8.65e+02	3.73	2.17	1.42	863.1	3.99	1.033e-11
2.9	7.67e+02	3.56	0.49	1.14	766.4	3.74	1.060e-11
3.0	6.73e+02	3.40	0.10	0.95	672.6	3.53	1.087e-11
3.1	5.84e+02	3.23	0.01	1.10	584.1	3.41	1.112e-11
3.2	5.00e+02	3.06	0.01	1.25	500.2	3.31	1.135e-11
3.3	4.30e+02	2.92	0.18	1.37	429.7	3.23	1.158e-11
3.4	3.79e+02	2.81	0.49	1.62	378.2	3.24	1.181e-11
3.5	3.32e+02	2.70	1.04	1.78	331.2	3.23	1.204e-11
3.6	2.88e+02	2.57	1.46	1.67	286.4	3.06	1.227e-11
3.7	2.53e+02	2.44	1.04	1.47	252.4	2.85	1.250e-11
3.8	2.26e+02	2.33	0.56	1.43	225.7	2.73	1.273e-11
3.9	2.04e+02	2.23	0.85	1.59	203.4	2.74	1.296e-11
4.0	1.85e+02	2.14	1.26	1.53	183.4	2.63	1.319e-11
4.1	1.65e+02	2.02	0.67	1.15	164.4	2.32	1.341e-11
4.2	1.48e+02	1.91	0.18	1.06	147.8	2.18	1.362e-11
4.3	1.34e+02	1.80	0.23	1.24	133.3	2.19	1.383e-11
4.4	1.20e+02	1.69	0.40	1.11	119.3	2.02	1.404e-11
4.5	1.07e+02	1.60	0.25	0.98	106.3	1.88	1.425e-11
4.6	9.51e+01	1.52	0.16	1.37	94.9	2.05	1.446e-11
4.7	8.36e+01	1.44	0.15	1.63	83.5	2.17	1.467e-11
4.8	7.09e+01	1.35	0.09	1.52	70.8	2.03	1.488e-11
4.9	5.95e+01	1.28	0.04	1.17	59.5	1.73	1.509e-11
5.0	5.09e+01	1.22	0.01	0.94	50.9	1.54	1.530e-11
5.1	4.44e+01	1.17	0.13	1.26	44.2	1.72	1.551e-11
5.2	3.88e+01	1.14	0.34	1.56	38.5	1.93	1.572e-11
5.3	3.44e+01	1.10	0.53	1.40	33.8	1.78	1.593e-11
5.4	3.03e+01	1.07	0.47	1.29	29.8	1.68	1.614e-11
5.5	2.65e+01	1.03	0.81	1.62	25.7	1.92	1.635e-11
5.6	2.38e+01	1.01	1.33	1.87	22.5	2.13	1.656e-11
5.7	2.23e+01	1.00	1.57	1.66	20.8	1.94	1.677e-11
5.8	2.10e+01	0.983	0.94	1.11	20.1	1.48	1.698e-11
5.9	1.93e+01	0.955	0.37	0.84	19.0	1.27	1.719e-11
6.0	1.79e+01	0.923	0.01	0.96	17.9	1.33	1.740e-11
6.1	1.73e+01	0.885	0.01	1.01	17.3	1.34	1.760e-11
6.2	1.74e+01	0.845	0.01	1.08	17.4	1.37	1.780e-11
6.3	1.75e+01	0.809	0.01	1.11	17.5	1.37	1.800e-11

TABLE A-3 (CONT'D)

Cf-252 gamma-ray spectra (Continued).							
Energy (MeV)	Gross	Error	Bkgd	Error	Net	Error	Kerr Ti (Gy/n/cm <sup>2</sup> )
	(γ/cm <sup>2</sup> .MeV.min)						
6.4	1.68e+01	0.767	0.01	1.15	16.8	1.38	1.820e-11
6.5	1.50e+01	0.724	0.01	1.35	14.9	1.53	1.840e-11
6.6	1.22e+01	0.686	0.01	1.30	12.2	1.47	1.860e-11
6.7	9.29e+00	0.653	0.01	1.11	9.3	1.29	1.880e-11
6.8	6.71e+00	0.626	0.01	1.06	6.7	1.23	1.900e-11
6.9	5.13e+00	0.604	0.01	0.91	5.1	1.09	1.920e-11
7.0	4.40e+00	0.583	0.03	0.77	4.4	0.97	1.940e-11
7.1	4.60e+00	0.560	0.28	1.14	4.3	1.27	1.960e-11
7.2	5.09e+00	0.541	0.91	1.71	4.2	1.79	1.980e-11
7.3	5.65e+00	0.522	1.51	2.13	4.1	2.19	2.000e-11
7.4	5.69e+00	0.501	1.94	2.03	3.8	2.09	2.020e-11
7.5	5.32e+00	0.477	1.35	1.58	4.0	1.65	2.040e-11
7.6	4.47e+00	0.450	0.78	1.25	3.7	1.33	2.060e-11
7.7	3.56e+00	0.426	0.27	0.95	3.3	1.04	2.080e-11
7.8	2.80e+00	0.405	0.01	0.67	2.8	0.78	2.100e-11
7.9	2.34e+00	0.389	0.01	0.70	2.3	0.80	2.120e-11
8.0	2.09e+00	0.377	0.03	1.03	2.1	1.10	2.140e-11
8.1	2.03e+00	0.366	0.06	1.34	2.0	1.39	2.160e-11
8.2	2.02e+00	0.354	0.08	1.54	1.9	1.58	2.180e-11
8.3	1.98e+00	0.342	0.11	1.56	1.9	1.60	2.200e-11
8.4	1.84e+00	0.331	0.08	1.29	1.8	1.33	2.220e-11
8.5	1.66e+00	0.326	0.06	1.05	1.6	1.10	2.240e-11
8.6	1.35e+00	0.322	0.03	1.22	1.3	1.26	2.260e-11
8.7	9.64e-01	0.319	0.01	1.67	1.0	1.70	2.280e-11
8.8	6.63e-01	0.314	0.01	1.98	0.7	2.00	2.300e-11
8.9	4.89e-01	0.307	0.01	1.98	0.5	2.00	2.320e-11
9.0	4.99e-01	0.299	0.01	1.71	0.5	1.74	2.340e-11
9.1	7.15e-01	0.294	0.01	1.35	0.7	1.38	2.360e-11
9.2	1.01e+00	0.290	0.01	1.26	1.0	1.29	2.380e-11
9.3	1.17e+00	0.286	0.01	1.28	1.2	1.31	2.400e-11
9.4	1.20e+00	0.282	0.01	1.32	1.2	1.35	2.420e-11
9.5	1.04e+00	0.275	0.01	1.57	1.0	1.59	2.440e-11
9.6	7.13e-01	0.269	0.01	1.90	0.7	1.92	2.460e-11
9.7	4.30e-01	0.267	0.01	2.01	0.4	2.03	2.480e-11
9.8	2.01e-01	0.269	0.01	1.74	0.2	1.76	2.500e-11
9.9	6.16e-02	0.273	0.01	1.30	0.1	1.33	2.520e-11
10.0	1.90e-02	0.274	0.06	1.27	0.0	1.30	2.540e-11
10.1	8.99e-03	0.272	0.66	1.75	0.0	1.77	2.560e-11
10.2	9.40e-03	0.267	1.09	2.42	0.0	2.43	2.581e-11
10.3	1.00e-02	0.263	1.51	2.87	0.0	2.88	2.602e-11
10.4	1.00e-02	0.265	1.86	2.79	0.0	2.80	2.622e-11
10.5	1.00e-02	0.271	1.44	2.39	0.0	2.41	2.643e-11
10.6	1.00e-02	0.279	1.03	2.17	0.0	2.19	2.663e-11
10.7	1.00e-02	0.285	0.62	2.16	0.0	2.18	2.684e-11
10.8	1.00e-02	0.289	0.12	2.06	0.0	2.08	2.705e-11
10.9	1.00e-02	0.290	0.22	1.96	0.0	1.98	2.725e-11
11.0	1.00e-02	0.291	0.65	2.21	0.0	2.23	2.746e-11
11.1	1.00e-02	0.295	0.92	2.49	0.0	2.51	2.766e-11
11.2	1.00e-02	0.302	1.07	2.67	0.0	2.69	2.787e-11
11.3	8.32e-02	0.309	1.17	2.68	0.0	2.70	2.808e-11
11.4	3.37e-01	0.312	0.90	2.29	0.0	2.31	2.828e-11
11.5	8.46e-01	0.315	0.58	1.76	0.0	1.79	2.849e-11
11.6	1.57e+00	0.320	0.88	1.54	0.0	1.57	2.869e-11
11.7	2.45e+00	0.324	1.13	1.67	0.0	1.70	2.890e-11
11.8	4.17e+00	0.865	0.01	6.18	0.0	6.24	2.911e-11
11.9	4.52e+00	0.879	5.94	7.79	0.0	7.84	2.931e-11
12.0	4.95e+00	0.645	3.96	4.99	0.0	5.03	2.952e-11
mr/min	8.98e-08		1.17e-08		7.81e-08		



TABLE A-4. GAMMA SPECTRUM OF PuBe STARTUP SOURCE

PuBe gamma-ray spectrum.					
Energy (MeV)	Flux	Error	Energy (MeV)	Flux	Error
	(γ/cm <sup>2</sup> .MeV.min)			(γ/cm <sup>2</sup> .MeV.min)	
0.2	74670	600.0	6.1	406	150.0
0.3	96990	701.0	6.2	293	145.0
0.4	198900	788.0	6.3	189	130.0
0.5	87180	587.0	6.4	169	116.0
0.6	38160	504.0	6.5	234	112.0
0.7	29730	502.0	6.6	348	112.0
0.8	25330	563.0	6.7	412	111.0
0.9	30100	550.0	6.8	383	101.0
1.0	16740	497.0	6.9	256	86.6
1.1	14100	468.0	7.0	155	78.5
1.2	12820	460.0	7.1	86	73.0
1.3	13480	452.0	7.2	60	67.0
1.4	10700	437.0	7.3	54	65.3
1.5	8815	440.0	7.4	53	62.6
1.6	7701	447.0	7.5	35	58.4
1.7	7826	460.0	7.6	23	56.7
1.8	7278	470.0	7.7	14	54.3
1.9	6350	486.0	7.8	21	52.6
2.0	6183	516.0	7.9	52	52.6
2.1	6517	523.0	8.0	83	56.4
2.2	6486	523.0	8.1	113	57.9
2.3	6907	527.0	8.2	109	50.0
2.4	7008	530.0	8.3	75	38.9
2.5	6867	541.0	8.4	44	33.9
2.6	7298	554.0	8.5	17	30.3
2.7	6921	561.0	8.6	4	25.7
2.8	5222	574.0	8.7	6	24.5
2.9	2919	593.0	8.8	9	28.0
3.0	1364	614.0	8.9	11	32.8
3.1	1731	643.0	9.0	12	33.8
3.2	1797	705.0	9.1	9	31.9
3.3	1773	804.0	9.2	6	29.0
3.4	3846	892.0	9.3	3	23.3
3.5	5724	919.0	9.4	0	15.6
3.6	4814	909.0	9.5	0	9.2
3.7	5339	960.0	9.6	0	6.0
3.8	8559	1090.0	9.7	0	9.1
3.9	10120	1190.0	9.8	0	13.9
4.0	8360	1170.0	9.9	1	19.2
4.1	7385	1040.0	10.0	1	21.0
4.2	15620	956.0	10.1	1	20.1
4.3	39170	1020.0	10.2	0	21.5
4.4	67620	1090.0	10.3	0	21.4
4.5	77610	1010.0	10.4	11	21.8
4.6	60380	790.0	10.5	24	26.7
4.7	32540	519.0	10.6	35	33.7
4.8	12790	318.0	10.7	45	35.8
4.9	4076	217.0	10.8	42	30.3
5.0	1593	184.0	10.9	31	22.1
5.1	973	174.0	11.0	21	13.8
5.2	680	169.0	11.1	6	5.9
5.3	465	164.0	11.2	0	0.0
5.4	327	159.0	11.3	0	0.0
5.5	259	155.0	11.4	0	0.0
5.6	307	158.0	11.5	0	0.0
5.7	451	160.0	11.6	0	0.0
5.8	570	155.0	11.7	0	0.0
5.9	572	150.0	11.8	0	0.0
6.0	513	150.0	11.9	0	0.0
			12.0	0	0.0

TABLE A-5. MEASURED GAMMA-RAY SPECTRA 2 METERS FROM THE REACTOR CENTER

Measured gamma-ray spectra 2 meters from reactor, SS94-12 (1/3).											
Energy (MeV)	Background			No background correction.			Background corrected.				
	0.00 w	Error	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$	0.01 w	Error	0.05 w	Error	0.01 w	Error	0.05 w	Error
	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$				
0.2	8.84e+04	135.0	1.01e+10	1.94e+07	3.13e+09	5.92e+06	1.22e+09	2.36e+07	1.37e+09	6.51e+06	
0.3	4.84e+04	108.0	5.84e+09	1.63e+07	2.07e+09	5.28e+06	9.99e+08	1.96e+07	1.12e+09	5.71e+06	
0.4	3.72e+04	115.0	4.77e+09	1.77e+07	1.95e+09	6.00e+06	1.05e+09	2.11e+07	1.23e+09	6.43e+06	
0.5	3.89e+04	116.0	5.23e+09	1.81e+07	2.30e+09	6.26e+06	1.34e+09	2.15e+07	1.53e+09	6.68e+06	
0.6	2.86e+04	119.0	3.87e+09	1.86e+07	1.79e+09	6.44e+06	1.01e+09	2.21e+07	1.22e+09	6.87e+06	
0.7	3.20e+04	155.0	4.19e+09	2.33e+07	1.79e+09	7.47e+06	9.93e+08	2.80e+07	1.15e+09	8.09e+06	
0.8	7.84e+04	186.0	9.18e+09	2.75e+07	2.91e+09	8.65e+06	1.34e+09	3.32e+07	1.34e+09	9.42e+06	
0.9	4.59e+04	136.0	5.39e+09	2.11e+07	2.11e+09	7.54e+06	7.99e+08	2.51e+07	1.19e+09	8.02e+06	
1.0	1.24e+04	98.3	2.01e+09	1.70e+07	1.24e+09	6.75e+06	7.77e+08	1.96e+07	9.96e+08	7.03e+06	
1.1	1.49e+04	105.0	2.27e+09	1.73e+07	1.20e+09	6.50e+06	7.80e+08	2.02e+07	9.02e+08	6.83e+06	
1.2	2.03e+04	106.0	2.73e+09	1.71e+07	1.23e+09	6.25e+06	6.96e+08	2.01e+07	8.20e+08	6.60e+06	
1.3	1.86e+04	95.1	2.51e+09	1.56e+07	1.13e+09	5.85e+06	6.50e+08	1.83e+07	7.58e+08	6.15e+06	
1.4	1.39e+04	72.7	1.88e+09	1.28e+07	9.40e+08	5.32e+06	4.91e+08	1.47e+07	6.64e+08	5.52e+06	
1.5	4.88e+03	46.6	9.62e+08	1.05e+07	6.87e+08	4.92e+06	4.74e+08	1.15e+07	5.90e+08	5.01e+06	
1.6	2.33e+03	40.5	6.69e+08	9.75e+06	5.71e+08	4.70e+06	4.36e+08	1.06e+07	5.25e+08	4.77e+06	
1.7	1.81e+03	37.9	5.68e+08	9.39e+06	5.02e+08	4.55e+06	3.87e+08	1.01e+07	4.67e+08	4.61e+06	
1.8	1.45e+03	36.0	5.07e+08	9.19e+06	4.52e+08	4.45e+06	3.62e+08	9.87e+06	4.23e+08	4.51e+06	
1.9	1.27e+03	35.9	4.69e+08	9.18e+06	4.18e+08	4.45e+06	3.42e+08	9.86e+06	3.93e+08	4.51e+06	
2.0	1.29e+03	36.8	4.56e+08	9.32e+06	4.08e+08	4.52e+06	3.27e+08	1.00e+07	3.83e+08	4.58e+06	
2.1	1.27e+03	34.8	4.29e+08	8.87e+06	3.82e+08	4.29e+06	3.02e+08	9.53e+06	3.57e+08	4.35e+06	
2.2	1.14e+03	32.1	3.75e+08	8.28e+06	3.28e+08	4.00e+06	2.62e+08	8.88e+06	3.06e+08	4.05e+06	
2.3	1.02e+03	30.3	3.22e+08	7.81e+06	2.77e+08	3.77e+06	2.20e+08	8.38e+06	2.58e+08	3.82e+06	
2.4	9.71e+02	29.1	2.87e+08	7.45e+06	2.43e+08	3.58e+06	1.90e+08	8.00e+06	2.24e+08	3.63e+06	
2.5	8.78e+02	26.6	2.53e+08	7.04e+06	2.11e+08	3.40e+06	1.65e+08	7.53e+06	1.94e+08	3.44e+06	
2.6	6.09e+02	22.4	2.11e+08	6.61e+06	1.84e+08	3.24e+06	1.50e+08	6.98e+06	1.72e+08	3.27e+06	
2.7	3.17e+02	19.2	1.71e+08	6.23e+06	1.60e+08	3.10e+06	1.39e+08	6.52e+06	1.54e+08	3.12e+06	
2.8	1.71e+02	18.1	1.42e+08	5.97e+06	1.39e+08	2.97e+06	1.25e+08	6.24e+06	1.36e+08	2.99e+06	
2.9	1.26e+02	18.0	1.26e+08	5.82e+06	1.21e+08	2.86e+06	1.13e+08	6.09e+06	1.19e+08	2.88e+06	
3.0	9.90e+01	18.6	1.12e+08	5.71e+06	1.07e+08	2.76e+06	1.03e+08	6.01e+06	1.05e+08	2.79e+06	
3.1	8.28e+01	20.0	9.98e+07	5.62e+06	9.64e+07	2.67e+06	9.15e+07	5.97e+06	9.50e+07	2.70e+06	
3.2	9.09e+01	21.1	8.82e+07	5.48e+06	8.78e+07	2.58e+06	7.91e+07	5.87e+06	8.62e+07	2.62e+06	
3.3	1.08e+02	21.0	7.83e+07	5.33e+06	8.05e+07	2.50e+06	6.75e+07	5.73e+06	7.85e+07	2.54e+06	
3.4	1.01e+02	21.0	7.01e+07	5.22e+06	7.28e+07	2.42e+06	6.00e+07	5.63e+06	7.12e+07	2.46e+06	
3.5	6.82e+01	22.5	5.98e+07	5.26e+06	6.43e+07	2.34e+06	5.29e+07	5.72e+06	6.36e+07	2.39e+06	
3.6	8.28e+01	24.8	5.53e+07	5.34e+06	5.71e+07	2.24e+06	4.70e+07	5.89e+06	5.66e+07	2.27e+06	
3.7	1.46e+02	25.0	5.84e+07	5.17e+06	5.16e+07	2.13e+06	4.38e+07	5.74e+06	5.12e+07	2.15e+06	
3.8	1.71e+02	22.4	5.87e+07	4.81e+06	4.79e+07	2.04e+06	4.17e+07	5.31e+06	4.76e+07	2.05e+06	
3.9	1.90e+02	20.3	5.95e+07	4.54e+06	4.54e+07	1.97e+06	4.05e+07	4.97e+06	4.51e+07	1.98e+06	
4.0	3.03e+02	21.5	7.15e+07	4.56e+06	4.19e+07	1.89e+06	4.12e+07	5.04e+06	4.16e+07	1.90e+06	
4.1	4.62e+02	22.6	8.74e+07	4.52e+06	3.63e+07	1.79e+06	4.12e+07	5.05e+06	3.61e+07	1.79e+06	
4.2	5.00e+02	20.6	8.33e+07	4.11e+06	3.03e+07	1.68e+06	3.33e+07	4.60e+06	3.02e+07	1.68e+06	
4.3	3.66e+02	15.5	6.13e+07	3.51e+06	2.48e+07	1.58e+06	2.47e+07	3.84e+06	2.46e+07	1.58e+06	
4.4	1.79e+02	9.8	3.80e+07	3.01e+06	2.07e+07	1.50e+06	2.01e+07	3.17e+06	2.06e+07	1.50e+06	

TABLE A-5 (CONT'D)

Measured gamma-ray spectra 2 meters from reactor, SS94-12, continued (2/3).												
Energy (MeV)	Background			No background correction.			Background corrected.			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$		
	0.00 w		Error	0.01 w		Error	0.05 w		Error	0.05 w		Error
	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$		
4.5	6.80e+01	6.6		2.23e+07	2.72e+06	1.84e+07	1.45e+06	1.55e+07	2.80e+06	1.83e+07	1.45e+06	
4.6	2.64e+01	5.5		1.46e+07	2.58e+06	1.75e+07	1.42e+06	1.19e+07	2.64e+06	1.75e+07	1.42e+06	
4.7	1.37e+01	4.7		1.26e+07	2.50e+06	1.72e+07	1.36e+06	1.12e+07	2.54e+06	1.72e+07	1.36e+06	
4.8	5.87e+00	4.0		1.11e+07	2.44e+06	1.58e+07	1.30e+06	1.05e+07	2.47e+06	1.57e+07	1.30e+06	
4.9	2.35e+00	3.8		9.53e+06	2.43e+06	1.40e+07	1.26e+06	9.29e+06	2.46e+06	1.39e+07	1.26e+06	
5.0	2.67e+00	4.2		8.92e+06	2.45e+06	1.25e+07	1.24e+06	8.65e+06	2.48e+06	1.25e+07	1.24e+06	
5.1	5.32e+00	4.5		8.32e+06	2.42e+06	1.10e+07	1.21e+06	7.79e+06	2.46e+06	1.10e+07	1.21e+06	
5.2	6.24e+00	4.4		6.85e+06	2.34e+06	8.86e+06	1.16e+06	6.23e+06	2.38e+06	8.85e+06	1.16e+06	
5.3	5.39e+00	4.2		6.62e+06	2.26e+06	7.30e+06	1.13e+06	6.08e+06	2.30e+06	7.29e+06	1.13e+06	
5.4	3.99e+00	4.2		8.40e+06	2.20e+06	6.89e+06	1.10e+06	8.00e+06	2.24e+06	6.88e+06	1.10e+06	
5.5	3.43e+00	4.2		1.03e+07	2.15e+06	7.11e+06	1.09e+06	9.98e+06	2.19e+06	7.10e+06	1.09e+06	
5.6	2.47e+00	4.0		1.15e+07	2.15e+06	7.77e+06	1.09e+06	1.13e+07	2.19e+06	7.76e+06	1.09e+06	
5.7	1.90e+00	3.8		1.15e+07	2.15e+06	8.06e+06	1.08e+06	1.13e+07	2.18e+06	8.05e+06	1.08e+06	
5.8	1.95e+00	3.8		9.87e+06	2.06e+06	7.65e+06	1.08e+06	9.68e+06	2.10e+06	7.64e+06	1.08e+06	
5.9	3.36e+00	3.9		6.54e+06	1.97e+06	6.18e+06	1.07e+06	6.21e+06	2.01e+06	6.18e+06	1.07e+06	
6.0	5.21e+00	3.9		3.47e+06	1.94e+06	4.68e+06	1.07e+06	2.95e+05	1.98e+06	4.68e+06	1.07e+06	
6.1	7.93e+00	4.1		1.46e+06	1.89e+06	3.08e+06	1.07e+06	6.67e+05	1.93e+06	3.08e+06	1.07e+06	
6.2	8.98e+00	4.1		5.68e+05	1.84e+06	2.32e+06	1.06e+06	-3.30e+05	1.86e+06	2.32e+06	1.06e+06	
6.3	7.39e+00	3.5		1.84e+05	1.83e+06	1.95e+06	1.06e+06	-5.55e+05	1.86e+06	1.95e+06	1.06e+06	
6.4	3.88e+00	2.9		1.90e+05	1.88e+06	2.69e+06	1.04e+06	-1.98e+05	1.90e+06	2.69e+06	1.04e+06	
6.5	1.27e+00	2.6		1.47e+06	1.99e+06	3.53e+06	1.01e+06	1.34e+06	2.01e+06	3.53e+06	1.01e+06	
6.6	3.09e-01	2.3		3.29e+06	2.06e+06	5.03e+06	9.85e+05	3.26e+06	2.07e+06	5.03e+06	9.85e+05	
6.7	8.73e-01	2.4		5.67e+06	2.01e+06	6.11e+06	9.53e+05	5.58e+06	2.02e+06	6.11e+06	9.53e+05	
6.8	1.91e+00	2.7		7.25e+06	1.92e+06	6.70e+06	9.11e+05	7.06e+06	1.94e+06	6.70e+06	9.11e+05	
6.9	2.72e+00	2.8		8.54e+06	1.87e+06	6.22e+06	8.72e+05	8.27e+06	1.89e+06	6.22e+06	8.72e+05	
7.0	2.55e+00	2.5		8.68e+06	1.78e+06	5.08e+06	8.46e+05	8.42e+06	1.80e+06	5.08e+06	8.46e+05	
7.1	1.61e+00	2.1		7.32e+06	1.61e+06	3.42e+06	8.20e+05	7.16e+06	1.62e+06	3.42e+06	8.20e+05	
7.2	8.38e-01	1.9		5.11e+06	1.45e+06	1.87e+06	7.84e+05	5.02e+06	1.46e+06	1.87e+06	7.84e+05	
7.3	5.01e-01	1.9		3.29e+06	1.31e+06	8.82e+05	7.40e+05	3.24e+06	1.32e+06	8.82e+05	7.40e+05	
7.4	7.23e-01	1.9		2.05e+06	1.16e+06	7.30e+05	6.99e+05	1.98e+06	1.18e+06	7.29e+05	6.99e+05	
7.5	8.88e-01	1.7		1.47e+06	1.09e+06	1.32e+06	6.76e+05	1.39e+06	1.09e+06	1.32e+06	6.76e+05	
7.6	1.05e+00	1.7		1.36e+06	1.07e+06	2.37e+06	6.75e+05	1.26e+06	1.10e+06	2.37e+06	6.75e+05	
7.7	6.95e-01	1.3		1.48e+06	1.15e+06	3.21e+06	6.67e+05	1.41e+06	1.16e+06	3.21e+06	6.67e+05	
7.8	3.97e-01	0.8		1.35e+06	1.13e+06	3.44e+06	6.36e+05	1.31e+06	1.13e+06	3.44e+06	6.36e+05	
7.9	1.89e-01	0.8		1.14e+06	9.32e+05	3.05e+06	5.90e+05	1.12e+06	1.04e+06	3.05e+06	5.90e+05	
8.0	1.31e-01	1.2		1.08e+06	8.52e+05	2.38e+06	5.30e+05	1.06e+06	9.40e+05	2.38e+06	5.30e+05	
8.1	2.69e-01	1.7		1.06e+06	8.52e+05	1.68e+06	4.64e+05	1.03e+06	8.68e+05	1.67e+06	4.64e+05	
8.2	4.40e-01	2.0		1.24e+06	8.55e+05	1.33e+06	4.15e+05	1.19e+06	8.77e+05	1.32e+06	4.15e+05	
8.3	5.16e-01	2.0		1.47e+06	8.43e+05	1.19e+06	3.88e+05	1.45e+06	8.67e+05	1.19e+06	3.88e+05	
8.4	4.90e-01	2.0		1.47e+06	7.52e+05	1.18e+06	3.74e+05	1.42e+06	7.78e+05	1.18e+06	3.74e+05	
8.5	3.78e-01	1.9		1.30e+06	6.44e+05	1.14e+06	3.50e+05	1.27e+06	6.70e+05	1.14e+06	3.50e+05	
8.6	2.17e-01	1.8		1.06e+06	5.86e+05	9.70e+05	3.09e+05	1.04e+06	6.13e+05	9.70e+05	3.09e+05	
8.7	1.04e-01	1.9		8.45e+05	5.63e+05	7.37e+05	2.68e+05	8.35e+05	5.93e+05	7.37e+05	2.68e+05	

TABLE A-5 (CONT'D)

Measured gamma-ray spectra 2 meters from reactor, SS94-12, continued (3/3).										
Background			No background correction.				Background corrected.			
Energy (MeV)	0.00 w	Error	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$			$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$				
			0.01 w	Error	0.05 w	Error	0.01 w	Error	0.05 w	Error
8.8	3.74e-02	1.9	6.14e+05	5.05e+05	5.29e+05	2.40e+05	6.10e+05	5.40e+05	5.29e+05	2.40e+05
8.9	1.00e-02	1.8	3.87e+05	4.29e+05	3.57e+05	2.20e+05	3.86e+05	4.66e+05	3.57e+05	2.20e+05
9.0	1.00e-02	1.5	2.28e+05	3.57e+05	2.63e+05	1.99e+05	2.27e+05	3.88e+05	2.63e+05	1.99e+05
9.1	1.00e-02	1.3	6.97e+04	3.17e+05	1.75e+05	1.81e+05	6.87e+04	3.41e+05	1.75e+05	1.81e+05
9.2	1.00e-02	1.3	1.00e-02	3.12e+05	1.07e+05	1.79e+05	-1.00e+03	3.39e+05	1.07e+05	1.79e+05
9.3	1.00e-02	1.5	1.31e+03	2.89e+05	8.44e+04	1.80e+05	3.09e+02	3.27e+05	8.44e+04	1.80e+05
9.4	1.00e-02	1.8	2.48e+03	2.74e+05	8.02e+04	1.73e+05	1.48e+03	3.25e+05	8.02e+04	1.73e+05
9.5	1.00e-02	2.0	3.62e+03	3.02e+05	1.20e+05	1.66e+05	2.62e+03	3.61e+05	1.20e+05	1.66e+05
9.6	1.74e-01	2.2	3.09e+04	3.23e+05	1.73e+05	1.66e+05	1.35e+04	3.93e+05	1.73e+05	1.66e+05
9.7	3.07e-01	2.5	8.21e+04	3.34e+05	1.92e+05	1.61e+05	5.14e+04	4.16e+05	1.92e+05	1.61e+05
9.8	4.36e-01	2.7	1.26e+05	3.83e+05	1.75e+05	1.48e+05	8.26e+04	4.66e+05	1.75e+05	1.48e+05
9.9	8.46e-01	2.7	1.84e+05	4.30e+05	1.45e+05	1.26e+05	9.90e+04	5.06e+05	1.45e+05	1.26e+05
10.0	9.30e-01	2.6	1.96e+05	4.28e+05	9.22e+04	1.03e+05	9.90e+04	5.02e+05	9.22e+04	1.03e+05
10.1	1.01e+00	2.6	1.63e+05	3.99e+05	4.99e+04	8.93e+04	6.15e+04	4.78e+05	4.99e+04	8.93e+04
10.2	1.09e+00	2.4	1.30e+05	3.49e+05	2.97e+04	8.89e+04	2.14e+04	4.21e+05	2.97e+04	8.89e+04
10.3	7.58e-01	2.0	7.79e+04	3.10e+05	1.63e+04	9.01e+04	2.08e+03	3.69e+05	1.63e+04	9.01e+04
10.4	5.92e-01	2.1	4.00e+04	3.41e+05	1.26e+04	8.10e+04	-1.93e+04	3.98e+05	1.26e+04	8.10e+04
10.5	4.74e-01	2.3	3.58e+04	3.87e+05	9.07e+03	7.18e+04	-1.17e+04	4.50e+05	9.07e+03	7.18e+04
10.6	3.25e-01	2.4	2.57e+04	3.89e+05	5.59e+03	7.17e+04	-6.74e+03	4.58e+05	5.59e+03	7.17e+04
10.7	7.45e-01	2.4	2.01e+04	3.39e+05	1.00e-02	6.88e+04	-5.44e+04	4.14e+05	-1.88e-02	6.88e+04
10.8	1.14e+00	2.3	1.79e+04	2.75e+05	1.68e+03	6.61e+04	9.59e+04	3.58e+05	1.68e+03	6.61e+04
10.9	1.73e+00	2.3	1.44e+04	2.49e+05	2.68e+03	7.78e+04	-1.58e+05	3.36e+05	2.68e+03	7.78e+04
11.0	2.05e+00	2.1	7.11e+03	2.67e+05	6.61e+03	9.80e+04	-1.98e+05	3.42e+05	6.61e+03	9.80e+04
11.1	1.99e+00	1.9	8.97e+03	2.56e+05	9.25e+03	1.10e+05	-1.90e+05	3.21e+05	9.25e+03	1.10e+05
11.2	1.78e+00	1.6	7.08e+03	2.07e+05	9.92e+03	1.09e+05	-1.71e+05	2.62e+05	9.92e+03	1.09e+05
11.3	1.24e+00	1.1	9.67e+03	1.91e+05	1.82e+04	1.00e+05	-1.14e+05	2.22e+05	1.82e+04	1.00e+05
11.4	6.17e-01	0.7	2.10e+04	2.72e+04	2.72e+04	8.82e+04	-4.07e+04	2.25e+05	2.72e+04	8.82e+04
11.5	3.31e-01	0.4	2.55e+04	2.84e+05	3.31e+04	8.73e+04	-7.55e+03	2.87e+05	3.31e+04	8.73e+04
11.6	1.00e-02	0.0	1.51e+05	3.59e+05	6.31e+04	9.29e+04	1.50e+05	3.59e+05	6.31e+04	9.29e+04
11.7	1.00e-02	0.0	2.80e+05	4.03e+05	7.22e+04	9.33e+04	2.79e+05	4.03e+05	7.22e+04	9.33e+04
11.8	1.00e-02	0.0	1.00e-02	1.25e+06	1.56e+04	2.86e+05	-1.00e+03	1.25e+06	1.55e+04	2.86e+05
11.9	1.00e-02	0.0	1.36e+06	1.54e+06	2.67e+05	2.82e+05	1.36e+06	1.54e+06	2.67e+05	2.82e+05
12.0	1.00e-02	0.0	7.53e+05	9.31e+05	1.00e-02	0.00e+00	7.52e+05	9.31e+05	8.66e-03	9.21e-04
mr/hr 9.64e-01		0.010	mr/kWhr 1.48e+05	2.67e+03	7.93e+04	1.20e+03	8.62e-03	2.89e+03	8.66e-03	1.21e+03



TABLE A-6. MEASURED GAMMA-RAY SPECTRA 5 METERS FROM THE REACTOR CENTER

Measured gamma-ray spectra 5 meters from reactor, SS94-11 (1/3).												
Energy (MeV)	Background			No background correction.					Background corrected.			
	0.00 w	Error		0.1 w	Error	0.5 w	Error		0.1 w	Error	0.5 w	Error
	$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{min}$			$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{kWmin}$					$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{kWmin}$			
0.2	2.45e+04	66.9		6.77e+08	1.20e+06	4.77e+08	8.22e+05		4.33e+08	1.37e+06	4.28e+08	8.33e+05
0.3	1.22e+04	52.1		3.98e+08	1.03e+06	3.04e+08	7.19e+05		2.78e+08	1.15e+06	2.80e+08	7.27e+05
0.4	8.40e+03	53.2		3.46e+08	1.15e+06	2.89e+08	8.24e+05		2.64e+08	1.27e+06	2.72e+08	8.31e+05
0.5	8.09e+03	52.9		4.20e+08	1.20e+06	3.55e+08	8.61e+05		3.39e+08	1.31e+06	3.38e+08	8.67e+05
0.6	5.87e+03	53.1		3.05e+08	1.19e+06	2.64e+08	8.66e+05		2.47e+08	1.30e+06	2.52e+08	8.72e+05
0.7	5.79e+03	68.6		2.70e+08	1.33e+06	2.36e+08	9.39e+05		2.12e+08	1.50e+06	2.24e+08	9.49e+05
0.8	1.58e+04	88.6		4.09e+08	1.60e+06	2.93e+08	1.09e+06		2.51e+08	1.83e+06	2.61e+08	1.10e+06
0.9	1.34e+04	68.1		3.94e+08	1.46e+06	2.96e+08	1.05e+06		2.61e+08	1.61e+06	2.69e+08	1.06e+06
1.0	2.11e+03	37.6		2.13e+08	1.25e+06	2.07e+08	9.64e+05		1.92e+08	1.31e+06	2.03e+08	9.67e+05
1.1	2.10e+03	42.7		1.82e+08	1.18e+06	1.74e+08	8.93e+05		1.61e+08	1.25e+06	1.70e+08	8.97e+05
1.2	3.80e+03	44.4		1.86e+08	1.14e+06	1.64e+08	8.53e+05		1.48e+08	1.22e+06	1.56e+08	8.58e+05
1.3	3.32e+03	40.2		1.73e+08	1.08e+06	1.55e+08	8.19e+05		1.39e+08	1.15e+06	1.49e+08	8.23e+05
1.4	2.76e+03	30.3		1.53e+08	1.01e+06	1.41e+08	7.79e+05		1.25e+08	1.05e+06	1.35e+08	7.81e+05
1.5	7.22e+02	13.9		1.16e+08	9.36e+05	1.19e+08	7.46e+05		1.09e+08	9.46e+05	1.17e+08	7.47e+05
1.6	1.94e+02	10.3		9.60e+07	8.99e+05	1.02e+08	7.17e+05		9.41e+07	9.05e+05	1.02e+08	7.17e+05
1.7	1.30e+02	8.8		8.73e+07	8.79e+05	9.13e+07	6.99e+05		8.60e+07	8.83e+05	9.10e+07	6.99e+05
1.8	6.88e+01	7.3		7.98e+07	8.60e+05	8.32e+07	6.84e+05		7.92e+07	8.63e+05	8.31e+07	6.84e+05
1.9	3.87e+01	7.0		7.24e+07	8.50e+05	7.58e+07	6.80e+05		7.20e+07	8.53e+05	7.57e+07	6.80e+05
2.0	3.28e+01	7.2		6.79e+07	8.62e+05	7.24e+07	6.91e+05		6.57e+07	8.65e+05	7.23e+07	6.91e+05
2.1	2.91e+01	6.8		6.59e+07	8.35e+05	6.99e+07	6.68e+05		6.57e+07	8.38e+05	6.99e+07	6.68e+05
2.2	2.46e+01	6.4		6.01e+07	7.84e+05	6.32e+07	6.28e+05		5.99e+07	7.87e+05	6.32e+07	6.28e+05
2.3	2.52e+01	6.5		4.90e+07	7.26e+05	5.27e+07	5.54e+05		4.89e+07	7.29e+05	5.26e+07	5.54e+05
2.4	3.64e+01	7.1		4.01e+07	6.86e+05	4.41e+07	5.10e+05		3.98e+07	6.90e+05	4.40e+07	5.10e+05
2.5	4.74e+01	7.2		3.54e+07	6.59e+05	3.87e+07	5.31e+05		3.50e+07	6.63e+05	3.87e+07	5.31e+05
2.6	4.08e+01	6.5		3.17e+07	6.32e+05	3.47e+07	5.10e+05		3.14e+07	6.35e+05	3.46e+07	5.10e+05
2.7	2.18e+01	5.7		2.80e+07	6.09e+05	3.05e+07	4.89e+05		2.78e+07	6.12e+05	3.04e+07	4.89e+05
2.8	9.76e+00	5.5		2.49e+07	5.87e+05	2.65e+07	4.69e+05		2.48e+07	5.90e+05	2.65e+07	4.69e+05
2.9	6.27e+00	5.8		2.19e+07	5.65e+05	2.33e+07	4.53e+05		2.18e+07	5.68e+05	2.33e+07	4.53e+05
3.0	5.01e+00	6.2		1.92e+07	5.46e+05	2.06e+07	4.40e+05		1.92e+07	5.50e+05	2.06e+07	4.40e+05
3.1	2.04e+00	6.7		1.74e+07	5.30e+05	1.89e+07	4.27e+05		1.74e+07	5.32e+05	1.89e+07	4.27e+05
3.2	9.48e-01	7.2		1.62e+07	5.17e+05	1.74e+07	4.15e+05		1.61e+07	5.18e+05	1.74e+07	4.15e+05
3.3	1.33e+00	7.5		1.49e+07	5.03e+05	1.57e+07	4.02e+05		1.49e+07	5.04e+05	1.57e+07	4.02e+05
3.4	5.60e+00	7.7		1.34e+07	4.88e+05	1.41e+07	3.90e+05		1.33e+07	4.89e+05	1.41e+07	3.90e+05
3.5	1.43e+01	8.3		1.15e+07	4.70e+05	1.27e+07	3.79e+05		1.15e+07	4.70e+05	1.27e+07	3.79e+05
3.6	1.63e+01	9.2		1.02e+07	4.53e+05	1.14e+07	3.66e+05		1.01e+07	4.53e+05	1.14e+07	3.66e+05
3.7	1.37e+01	9.7		9.43e+06	4.37e+05	1.04e+07	3.51e+05		9.43e+06	4.37e+05	1.03e+07	3.51e+05
3.8	1.70e+01	9.5		8.88e+06	4.23e+05	9.57e+06	3.38e+05		8.88e+06	4.23e+05	9.57e+06	3.38e+05
3.9	1.80e+01	8.3		8.52e+06	4.10e+05	8.75e+06	3.25e+05		8.51e+06	4.10e+05	8.75e+06	3.25e+05
4.0	2.11e+01	7.8		7.83e+06	3.93e+05	8.00e+06	3.13e+05		7.82e+06	3.93e+05	8.00e+06	3.13e+05
4.1	4.57e+01	8.6		6.75e+06	3.74e+05	7.36e+06	3.00e+05		6.74e+06	3.74e+05	7.36e+06	3.00e+05
4.2	7.29e+01	9.0		6.01e+06	3.59e+05	6.67e+06	2.87e+05		6.01e+06	3.59e+05	6.66e+06	2.87e+05
4.3	7.42e+01	7.9		5.49e+06	3.42e+05	5.97e+06	2.75e+05		5.49e+06	3.42e+05	5.97e+06	2.75e+05
4.4	5.06e+01	6.0		4.86e+06	3.24e+05	5.15e+06	2.63e+05		4.86e+06	3.24e+05	5.15e+06	2.63e+05

TABLE A-6 (CONT'D)

Measured gamma-ray spectra 5 meters from reactor, SS94-11, continued (2/3).											
Energy (MeV)	Background			No background correction.			Background corrected.				
	0.00 w	Error	$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{min}$	0.1 w	Error	0.5 w	Error	0.1 w	Error	0.5 w	Error
4.5	2.57e+01	4.2	4.21e+06	3.13e+05	4.20e+06	2.53e+05	4.21e+06	3.13e+05	4.20e+06	2.53e+05	4.20e+06
4.6	1.02e+01	3.0	3.71e+06	3.07e+05	3.54e+06	2.46e+05	3.71e+06	3.07e+05	3.54e+06	2.46e+05	3.54e+06
4.7	4.41e+00	2.6	3.32e+06	3.02e+05	3.16e+06	2.41e+05	3.32e+06	3.02e+05	3.16e+06	2.41e+05	3.16e+06
4.8	2.92e+00	2.5	2.79e+06	2.93e+05	2.88e+06	2.35e+05	2.78e+06	2.93e+05	2.88e+06	2.35e+05	2.88e+06
4.9	2.25e+00	2.3	2.20e+06	2.84e+05	2.78e+06	2.30e+05	2.20e+06	2.84e+05	2.78e+06	2.30e+05	2.78e+06
5.0	1.74e+00	2.3	2.00e+06	2.79e+05	2.82e+06	2.28e+05	2.00e+06	2.79e+05	2.82e+06	2.28e+05	2.82e+06
5.1	1.51e+00	2.2	2.11e+06	2.78e+05	2.82e+06	2.25e+05	2.11e+06	2.78e+05	2.82e+06	2.25e+05	2.82e+06
5.2	1.02e+00	2.1	2.26e+06	2.78e+05	2.76e+06	2.22e+05	2.26e+06	2.78e+05	2.76e+06	2.22e+05	2.76e+06
5.3	6.89e-01	2.2	2.34e+06	2.77e+05	2.53e+06	2.18e+05	2.34e+06	2.77e+05	2.53e+06	2.18e+05	2.53e+06
5.4	4.17e-01	2.2	2.27e+06	2.72e+05	2.16e+06	2.13e+05	2.27e+06	2.72e+05	2.16e+06	2.13e+05	2.16e+06
5.5	2.18e-01	1.9	1.98e+06	2.66e+05	1.79e+06	2.11e+05	1.98e+06	2.66e+05	1.79e+06	2.11e+05	1.79e+06
5.6	1.02e-01	1.8	1.69e+06	2.63e+05	1.59e+06	2.09e+05	1.69e+06	2.63e+05	1.59e+06	2.09e+05	1.59e+06
5.7	2.49e-01	1.9	1.58e+06	2.61e+05	1.47e+06	2.07e+05	1.58e+06	2.61e+05	1.47e+06	2.07e+05	1.47e+06
5.8	8.62e-01	2.2	1.57e+06	2.58e+05	1.51e+06	2.07e+05	1.57e+06	2.58e+05	1.51e+06	2.07e+05	1.51e+06
5.9	1.47e+00	2.4	1.53e+06	2.56e+05	1.64e+06	2.06e+05	1.53e+06	2.56e+05	1.64e+06	2.06e+05	1.64e+06
6.0	1.73e+00	2.3	1.57e+06	2.56e+05	1.80e+06	2.06e+05	1.57e+06	2.56e+05	1.80e+06	2.06e+05	1.80e+06
6.1	1.19e+00	2.1	1.53e+06	2.57e+05	1.80e+06	2.05e+05	1.53e+06	2.57e+05	1.80e+06	2.05e+05	1.80e+06
6.2	7.01e-01	2.0	1.42e+06	2.58e+05	1.69e+06	2.07e+05	1.42e+06	2.58e+05	1.69e+06	2.07e+05	1.69e+06
6.3	2.21e-01	2.0	1.12e+06	2.59e+05	1.36e+06	2.07e+05	1.12e+06	2.59e+05	1.36e+06	2.07e+05	1.36e+06
6.4	3.42e-01	2.1	8.93e+05	2.56e+05	9.30e+05	2.04e+05	8.93e+05	2.56e+05	9.30e+05	2.04e+05	9.30e+05
6.5	4.61e-01	2.2	6.04e+05	2.51e+05	4.99e+05	2.02e+05	6.04e+05	2.51e+05	4.99e+05	2.02e+05	4.99e+05
6.6	6.55e-01	2.0	5.20e+05	2.49e+05	3.27e+05	2.02e+05	5.20e+05	2.49e+05	3.27e+05	2.02e+05	3.27e+05
6.7	4.45e-01	1.7	5.57e+05	2.49e+05	4.31e+05	1.99e+05	5.57e+05	2.49e+05	4.31e+05	1.99e+05	4.31e+05
6.8	2.45e-01	1.6	8.30e+05	2.46e+05	8.20e+05	1.94e+05	8.30e+05	2.46e+05	8.20e+05	1.94e+05	8.20e+05
6.9	5.49e-02	1.5	1.09e+06	2.36e+05	1.32e+06	1.87e+05	1.09e+06	2.36e+05	1.32e+06	1.87e+05	1.32e+06
7.0	1.00e-02	1.5	1.40e+06	2.24e+05	1.78e+06	1.79e+05	1.39e+06	2.24e+05	1.78e+06	1.79e+05	1.78e+06
7.1	1.00e-02	1.7	1.63e+06	2.14e+05	2.02e+06	1.72e+05	1.63e+06	2.14e+05	2.02e+06	1.72e+05	2.02e+06
7.2	5.96e-02	1.8	1.77e+06	2.04e+05	1.99e+06	1.63e+05	1.77e+06	2.04e+05	1.99e+06	1.63e+05	1.99e+06
7.3	2.04e-01	1.8	1.66e+06	1.90e+05	1.66e+06	1.52e+05	1.66e+06	1.90e+05	1.66e+06	1.52e+05	1.66e+06
7.4	3.42e-01	1.9	1.38e+06	1.76e+05	1.18e+06	1.39e+05	1.38e+06	1.76e+05	1.18e+06	1.39e+05	1.18e+06
7.5	4.74e-01	1.9	9.71e+05	1.62e+05	7.26e+05	1.27e+05	9.71e+05	1.62e+05	7.26e+05	1.27e+05	7.26e+05
7.6	3.38e-01	1.6	5.61e+05	1.50e+05	4.47e+05	1.20e+05	5.61e+05	1.50e+05	4.47e+05	1.20e+05	4.47e+05
7.7	2.07e-01	1.4	2.61e+05	1.43e+05	3.31e+05	1.16e+05	2.61e+05	1.43e+05	3.31e+05	1.16e+05	3.31e+05
7.8	8.17e-02	1.4	8.75e+04	1.38e+05	3.61e+05	1.13e+05	1.01e+05	1.38e+05	3.61e+05	1.13e+05	3.61e+05
7.9	1.00e-02	1.6	7.05e+05	1.34e+05	4.29e+05	1.10e+05	8.75e+04	1.34e+05	4.28e+05	1.10e+05	4.28e+05
8.0	1.00e-02	1.7	2.01e+05	1.32e+05	4.85e+05	1.04e+05	2.01e+05	1.32e+05	4.84e+05	1.04e+05	4.84e+05
8.1	2.73e-01	2.0	3.86e+05	1.30e+05	5.03e+05	9.79e+04	3.86e+05	1.30e+05	5.03e+05	9.79e+04	5.03e+05
8.2	7.85e-01	2.4	5.77e+05	1.25e+05	4.99e+05	9.19e+04	5.77e+05	1.25e+05	4.99e+05	9.19e+04	4.99e+05
8.3	1.33e+00	2.8	6.89e+05	1.18e+05	4.56e+05	8.59e+04	6.89e+05	1.18e+05	4.56e+05	8.59e+04	4.56e+05
8.4	1.87e+00	3.0	6.75e+05	1.09e+05	4.03e+05	7.96e+04	6.75e+05	1.09e+05	4.03e+05	7.96e+04	4.03e+05
8.5	1.66e+00	3.0	5.78e+05	9.66e+04	3.43e+05	7.26e+04	5.78e+05	9.66e+04	3.43e+05	7.26e+04	3.43e+05
8.6	1.15e+00	2.8	4.13e+05	8.16e+04	2.74e+05	6.61e+04	4.12e+05	8.16e+04	2.74e+05	6.61e+04	2.74e+05
8.7	6.50e-01	2.5	2.46e+05	6.82e+04	2.19e+05	6.16e+04	2.46e+05	6.82e+04	2.19e+05	6.16e+04	2.19e+05

TABLE A-6 (CONT'D)

Measured gamma-ray spectra 5 meters from reactor, SS94-11, continued (3/3).										
Energy (MeV)	Background			No background correction.			Background corrected.			
	0.00 w	Error		0.1 w	Error	0.5 w	Error	0.1 w	Error	0.5 w
	$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{min}$			$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{kWmin}$			$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{kWmin}$			
8.8	1.76e-01	2.2		1.37e+05	6.01e+04	1.79e+05	6.01e+04	1.37e+05	6.01e+04	1.79e+05
8.9	2.35e-02	2.3		7.57e+04	5.59e+04	1.46e+05	5.59e+04	7.57e+04	5.59e+04	1.46e+05
9.0	1.68e-02	2.6		5.54e+04	5.18e+04	1.25e+05	5.18e+04	5.54e+04	5.18e+04	1.25e+05
9.1	1.00e-02	2.7		5.90e+04	4.92e+04	1.10e+05	4.92e+04	5.90e+04	4.92e+04	1.10e+05
9.2	1.00e-02	2.4		7.02e+04	4.83e+04	9.71e+04	4.83e+04	7.02e+04	4.83e+04	9.71e+04
9.3	5.12e-01	2.2		6.92e+04	4.56e+04	8.49e+04	4.56e+04	6.92e+04	4.56e+04	8.49e+04
9.4	1.05e+00	2.4		6.11e+04	4.24e+04	6.94e+04	4.24e+04	6.11e+04	4.24e+04	6.94e+04
9.5	1.56e+00	2.8		5.41e+04	3.94e+04	5.48e+04	3.94e+04	5.41e+04	3.94e+04	5.48e+04
9.6	2.05e+00	3.0		3.73e+04	3.60e+04	4.24e+04	3.60e+04	3.73e+04	3.60e+04	4.24e+04
9.7	1.69e+00	2.8		2.32e+04	3.33e+04	2.99e+04	3.33e+04	2.32e+04	3.33e+04	2.99e+04
9.8	1.20e+00	2.4		1.60e+04	3.07e+04	2.36e+04	3.07e+04	1.60e+04	3.07e+04	2.36e+04
9.9	7.23e-01	1.8		9.53e+03	2.95e+04	2.02e+04	2.95e+04	9.53e+03	2.95e+04	2.02e+04
10.0	1.04e-01	1.2		7.30e+03	2.96e+04	1.13e+04	2.96e+04	7.30e+03	2.96e+04	1.13e+04
10.1	1.00e-02	0.9		7.34e+03	2.96e+04	7.79e+03	2.96e+04	7.34e+03	2.96e+04	7.79e+03
10.2	1.00e-02	0.9		6.71e+03	2.88e+04	4.11e+03	2.88e+04	6.71e+03	2.88e+04	4.11e+03
10.3	1.00e-02	1.2		7.76e+03	2.87e+04	1.00e-02	2.87e+04	7.76e+03	2.87e+04	1.00e-02
10.4	1.00e-02	1.4		8.81e+03	2.97e+04	3.77e+03	2.97e+04	8.81e+03	2.97e+04	3.77e+03
10.5	1.00e-02	1.4		1.02e+04	3.04e+04	6.24e+03	3.04e+04	1.02e+04	3.04e+04	6.24e+03
10.6	1.00e-02	1.4		1.24e+04	3.03e+04	1.07e+04	3.03e+04	1.24e+04	3.03e+04	1.07e+04
10.7	1.00e-02	1.6		1.66e+04	2.88e+04	1.90e+04	2.88e+04	1.66e+04	2.88e+04	1.90e+04
10.8	1.00e-02	1.6		1.83e+04	2.74e+04	2.26e+04	2.74e+04	1.83e+04	2.74e+04	2.26e+04
10.9	1.00e-02	1.8		1.92e+04	2.66e+04	2.55e+04	2.66e+04	1.92e+04	2.66e+04	2.55e+04
11.0	1.00e-02	2.3		1.67e+04	2.47e+04	2.78e+04	2.47e+04	1.67e+04	2.47e+04	2.78e+04
11.1	1.00e-02	2.7		1.21e+04	2.03e+04	2.26e+04	2.03e+04	1.21e+04	2.03e+04	2.26e+04
11.2	1.00e-02	2.8		8.12e+03	1.49e+04	1.90e+04	1.49e+04	8.12e+03	1.49e+04	1.90e+04
11.3	1.00e-02	2.7		6.75e+03	1.18e+04	1.45e+04	1.18e+04	6.75e+03	1.18e+04	1.45e+04
11.4	9.12e-01	2.6		6.37e+03	1.19e+04	7.74e+03	1.19e+04	6.37e+03	1.19e+04	7.74e+03
11.5	1.56e+00	2.7		8.96e+03	1.47e+04	4.31e+03	1.47e+04	8.96e+03	1.47e+04	4.31e+03
11.6	2.79e+00	3.1		1.15e+04	1.62e+04	2.95e+03	1.62e+04	1.15e+04	1.62e+04	2.95e+03
11.7	4.05e+00	3.3		1.12e+04	1.43e+04	5.42e+02	1.43e+04	1.12e+04	1.43e+04	5.42e+02
11.8	1.96e+00	8.0		1.00e-02	0.00e+00	1.00e-02	0.00e+00	9.96e-03	6.14e-05	9.99e-03
11.9	7.85e+00	8.7		1.00e-02	0.00e+00	1.00e-02	0.00e+00	9.97e-03	4.85e-05	9.99e-03
12.0	4.34e+00	5.3		1.00e-02	0.00e+00	1.00e-02	0.00e+00	9.98e-03	3.83e-05	1.00e-02
mr/hr	1.90e-01	.0053		mr/kW hr	1.36e+04	2.55e+02	2.55e+02	mr/kW hr	1.17e+04	2.58e+02
						1.28e+04	1.28e+04			1.24e+04
										2.02e+02

TABLE A-7. MEASURED GAMMA-RAY SPECTRUM BEHIND BISMUTH SHIELD BEFORE  
BACKGROUND SUBTRACTION

Measured gamma-ray spectra behind bismuth shield, no background subtraction (1/3).									
Energy (MeV)	Background		At power.		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$				
	0.00 w	Error	0.01 w	Error	0.02 w	Error	0.05 w	Error	0.1 w
	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$
0.2	2.61e+05	429.0	2.97e+10	4.85e+07	1.50e+10	2.43e+07	7.62e+09	1.22e+07	5.03e+09
0.3	2.00e+05	324.0	2.24e+10	3.62e+07	1.11e+10	1.80e+07	5.47e+09	8.88e+06	3.51e+09
0.4	1.50e+05	278.0	1.65e+10	3.12e+07	8.06e+09	1.54e+07	3.93e+09	7.73e+06	2.55e+09
0.5	1.37e+05	261.0	1.56e+10	3.04e+07	7.87e+09	1.43e+07	4.05e+09	7.27e+06	2.73e+09
0.6	1.26e+05	260.0	1.41e+10	3.07e+07	7.02e+09	1.33e+07	3.54e+09	6.51e+06	2.37e+09
0.7	8.07e+04	281.0	9.43e+09	3.31e+07	4.85e+09	1.40e+07	2.62e+09	6.46e+06	1.87e+09
0.8	1.56e+05	430.0	1.70e+10	4.86e+07	8.54e+09	2.19e+07	4.23e+09	9.89e+06	2.75e+09
0.9	3.57e+05	435.0	3.86e+10	4.92e+07	1.81e+10	2.24e+07	7.94e+09	1.01e+07	4.57e+09
1.0	1.30e+05	261.0	1.53e+10	3.20e+07	7.51e+09	1.37e+07	3.73e+09	6.48e+06	2.49e+09
1.1	4.15e+04	203.0	5.29e+09	2.49e+07	2.89e+09	1.09e+07	1.71e+09	5.33e+06	1.32e+09
1.2	6.23e+04	235.0	7.03e+09	2.77e+07	3.63e+09	1.18e+07	1.89e+09	5.49e+06	1.30e+09
1.3	9.05e+04	235.0	9.80e+09	2.78e+07	4.71e+09	1.17e+07	2.18e+09	5.34e+06	1.34e+09
1.4	7.28e+04	193.0	8.09e+09	2.33e+07	3.88e+09	9.94e+06	1.83e+09	4.70e+06	1.15e+09
1.5	4.02e+04	131.0	4.73e+09	1.70e+07	2.36e+09	7.70e+06	1.22e+09	4.02e+06	8.76e+08
1.6	1.22e+04	76.6	1.86e+09	1.22e+07	1.15e+09	6.22e+06	8.19e+08	3.68e+06	7.31e+08
1.7	5.65e+03	66.4	1.21e+09	1.14e+07	8.79e+08	5.47e+06	7.33e+08	3.58e+06	6.84e+08
1.8	4.37e+03	58.8	9.70e+08	1.04e+07	7.04e+08	5.94e+06	5.86e+08	3.32e+06	5.45e+08
1.9	2.65e+03	50.3	6.40e+08	9.28e+06	4.83e+08	5.01e+06	4.15e+08	3.10e+06	3.93e+08
2.0	1.71e+03	47.8	4.52e+08	8.95e+06	3.55e+08	4.90e+06	3.19e+08	3.08e+06	3.14e+08
2.1	1.43e+03	45.9	4.08e+08	8.88e+06	3.30e+08	4.91e+06	3.17e+08	3.13e+06	3.24e+08
2.2	1.25e+03	43.5	4.63e+08	9.00e+06	3.92e+08	5.03e+06	3.92e+08	3.22e+06	3.97e+08
2.3	9.82e+02	40.5	4.79e+08	8.58e+06	4.20e+08	4.81e+06	4.12e+08	3.05e+06	4.03e+08
2.4	7.27e+02	38.5	3.71e+08	7.69e+06	3.27e+08	4.32e+06	3.14e+08	2.74e+06	3.07e+08
2.5	6.08e+02	38.1	2.64e+08	7.17e+06	2.40e+08	4.07e+06	2.40e+08	2.62e+06	2.42e+08
2.6	6.08e+02	38.5	2.51e+08	7.15e+06	2.36e+08	4.07e+06	2.41e+08	2.61e+06	2.43e+08
2.7	6.11e+02	38.6	2.63e+08	7.04e+06	2.42e+08	3.96e+06	2.37e+08	2.52e+06	2.37e+08
2.8	5.16e+02	38.2	2.33e+08	6.63e+06	2.07e+08	3.71e+06	1.97e+08	2.36e+06	1.96e+08
2.9	3.78e+02	38.5	1.82e+08	6.25e+06	1.59e+08	3.49e+06	1.52e+08	2.23e+06	1.53e+08
3.0	3.01e+02	39.4	1.49e+08	6.04e+06	1.30e+08	3.39e+06	1.28e+08	2.18e+06	1.31e+08
3.1	2.81e+02	40.3	1.32e+08	5.88e+06	1.18e+08	3.32e+06	1.18e+08	2.13e+06	1.20e+08
3.2	2.39e+02	42.2	1.18e+08	5.75e+06	1.09e+08	3.24e+06	1.08e+08	2.08e+06	1.09e+08
3.3	1.98e+02	46.3	1.07e+08	5.61e+06	9.49e+07	3.14e+06	9.56e+07	2.02e+06	9.76e+07
3.4	2.08e+02	51.2	9.54e+07	5.49e+06	8.21e+07	3.09e+06	8.35e+07	1.98e+06	8.61e+07
3.5	2.15e+02	54.0	8.50e+07	5.41e+06	7.65e+07	3.08e+06	7.57e+07	1.96e+06	7.65e+07
3.6	2.12e+02	54.1	8.05e+07	5.35e+06	7.14e+07	3.04e+06	7.18e+07	1.93e+06	6.99e+07
3.7	2.83e+02	55.0	7.83e+07	5.26e+06	6.32e+07	2.95e+06	6.69e+07	1.88e+06	6.52e+07
3.8	3.87e+02	60.1	7.05e+07	5.14e+06	5.65e+07	2.89e+06	6.15e+07	1.85e+06	6.17e+07
3.9	4.76e+02	67.2	6.21e+07	5.06e+06	5.34e+07	2.86e+06	5.88e+07	1.82e+06	5.94e+07
4.0	5.23e+02	69.4	5.71e+07	4.98e+06	5.22e+07	2.82e+06	5.57e+07	1.79e+06	5.68e+07
4.1	4.48e+02	63.7	5.15e+07	4.83e+06	5.18e+07	2.75e+06	5.08e+07	1.74e+06	5.42e+07
4.2	5.08e+02	56.7	4.79e+07	4.73e+06	5.27e+07	2.68e+06	4.65e+07	1.70e+06	5.11e+07
4.3	1.09e+03	56.6	4.90e+07	4.67e+06	5.19e+07	2.62e+06	4.26e+07	1.66e+06	4.70e+07
4.4	2.16e+03	60.9	4.91e+07	4.59e+06	4.96e+07	2.55e+06	3.80e+07	1.63e+06	4.24e+07



TABLE A-7 (CONT'D)

Measured gamma-ray spectra behind bismuth shield, no background subtraction, continued (2/3).											
Energy (MeV)	Background		At power.								
	0.00 w	Error	0.01 w	Error	0.02 w	Error	0.05 w	Error	0.1 w	Error	
	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$										
4.5	2.90e+03	60.3	4.75e+07	4.49e+06	4.64e+07	2.48e+06	3.44e+07	1.59e+06	3.77e+07	1.28e+06	
4.6	2.68e+03	51.5	4.44e+07	4.36e+06	3.98e+07	2.40e+06	3.27e+07	1.56e+06	3.29e+07	1.26e+06	
4.7	1.75e+03	38.1	4.24e+07	4.28e+06	3.27e+07	2.35e+06	3.35e+07	1.53e+06	2.97e+07	1.25e+06	
4.8	8.71e+02	26.6	3.92e+07	4.23e+06	2.73e+07	2.34e+06	3.54e+07	1.53e+06	2.84e+07	1.24e+06	
4.9	3.58e+02	19.4	3.58e+07	4.20e+06	2.31e+07	2.34e+06	3.61e+07	1.52e+06	2.73e+07	1.24e+06	
5.0	1.46e+02	15.8	3.20e+07	4.16e+06	1.90e+07	2.34e+06	3.34e+07	1.51e+06	2.62e+07	1.23e+06	
5.1	7.76e+01	14.4	2.76e+07	4.10e+06	1.83e+07	2.34e+06	2.73e+07	1.50e+06	2.61e+07	1.23e+06	
5.2	6.04e+01	13.8	2.27e+07	4.10e+06	1.91e+07	2.34e+06	2.01e+07	1.50e+06	2.64e+07	1.23e+06	
5.3	5.81e+01	13.5	2.04e+07	4.14e+06	2.22e+07	2.35e+06	1.42e+07	1.51e+06	2.57e+07	1.23e+06	
5.4	5.64e+01	13.4	1.98e+07	4.18e+06	2.51e+07	2.40e+06	1.08e+07	1.53e+06	2.36e+07	1.24e+06	
5.5	4.89e+01	13.4	1.97e+07	4.20e+06	2.72e+07	2.43e+06	1.11e+07	1.54e+06	2.04e+07	1.25e+06	
5.6	3.04e+01	13.7	1.99e+07	4.24e+06	2.43e+07	2.44e+06	1.55e+07	1.55e+06	1.70e+07	1.26e+06	
5.7	1.56e+01	13.5	2.23e+07	4.29e+06	2.02e+07	2.44e+06	2.19e+07	1.56e+06	1.47e+07	1.27e+06	
5.8	4.69e+00	12.7	2.54e+07	4.31e+06	1.54e+07	2.44e+06	2.81e+07	1.57e+06	1.50e+07	1.27e+06	
5.9	7.02e+00	12.0	2.67e+07	4.34e+06	1.44e+07	2.46e+06	3.14e+07	1.60e+06	1.83e+07	1.28e+06	
6.0	2.02e+01	12.3	2.61e+07	4.39e+06	1.53e+07	2.46e+06	3.05e+07	1.61e+06	2.23e+07	1.29e+06	
6.1	4.37e+01	13.0	2.35e+07	4.41e+06	1.93e+07	2.45e+06	2.44e+07	1.60e+06	2.54e+07	1.29e+06	
6.2	6.11e+01	13.0	1.94e+07	4.41e+06	2.28e+07	2.44e+06	1.68e+07	1.57e+06	2.62e+07	1.28e+06	
6.3	6.27e+01	12.1	1.46e+07	4.39e+06	2.57e+07	2.44e+06	1.04e+07	1.56e+06	2.45e+07	1.28e+06	
6.4	4.77e+01	11.1	1.23e+07	4.34e+06	2.52e+07	2.44e+06	8.36e+06	1.55e+06	2.02e+07	1.27e+06	
6.5	2.93e+01	10.2	1.37e+07	4.29e+06	2.20e+07	2.44e+06	9.56e+06	1.56e+06	1.50e+07	1.27e+06	
6.6	1.51e+01	9.52	1.76e+07	4.28e+06	1.57e+07	2.44e+06	1.76e+07	1.58e+06	1.05e+07	1.27e+06	
6.7	8.98e+00	8.82	2.21e+07	4.29e+06	9.83e+06	2.45e+06	1.76e+07	1.58e+06	8.06e+06	1.27e+06	
6.8	7.36e+00	8.46	2.47e+07	4.30e+06	5.43e+06	2.46e+06	2.02e+07	1.57e+06	7.82e+06	1.27e+06	
6.9	1.03e+01	8.78	2.39e+07	4.30e+06	4.74e+06	2.47e+06	2.00e+07	1.56e+06	1.01e+07	1.28e+06	
7.0	1.37e+01	9.21	1.90e+07	4.27e+06	6.76e+06	2.47e+06	1.85e+07	1.56e+06	1.37e+07	1.28e+06	
7.1	1.47e+01	9.25	1.35e+07	4.23e+06	1.16e+07	2.46e+06	1.55e+07	1.54e+06	1.74e+07	1.26e+06	
7.2	1.11e+01	8.94	9.88e+06	4.14e+06	1.74e+07	2.42e+06	1.30e+07	1.50e+06	2.03e+07	1.22e+06	
7.3	7.86e+00	8.37	9.96e+06	3.99e+06	2.28e+07	2.32e+06	1.20e+07	1.45e+06	2.24e+07	1.17e+06	
7.4	4.79e+00	7.90	1.36e+07	3.84e+06	2.65e+07	2.19e+06	1.38e+07	1.38e+06	2.32e+07	1.12e+06	
7.5	5.73e+00	7.73	2.04e+07	3.69e+06	2.80e+07	2.09e+06	1.73e+07	1.33e+06	2.31e+07	1.07e+06	
7.6	8.83e+00	7.62	2.65e+07	3.56e+06	2.67e+07	2.01e+06	2.16e+07	1.29e+06	2.18e+07	1.03e+06	
7.7	1.37e+01	7.34	2.95e+07	3.42e+06	2.30e+07	1.92e+06	2.39e+07	1.24e+06	1.94e+07	9.80e+05	
7.8	1.60e+01	6.91	2.73e+07	3.27e+06	1.74e+07	1.83e+06	2.30e+07	1.18e+06	1.62e+07	9.31e+05	
7.9	1.68e+01	6.45	2.21e+07	3.10e+06	1.13e+07	1.74e+06	1.94e+07	1.11e+06	1.32e+07	8.84e+05	
8.0	1.45e+01	6.02	1.46e+07	2.93e+06	7.18e+06	1.68e+06	1.43e+07	1.05e+06	1.09e+07	8.45e+05	
8.1	1.13e+01	5.50	8.37e+06	2.80e+06	5.88e+06	1.61e+06	9.41e+06	1.01e+06	9.45e+06	8.20e+05	
8.2	7.13e+00	4.92	5.15e+06	2.68e+06	6.57e+06	1.56e+06	6.20e+06	9.80e+05	8.58e+06	8.05e+05	
8.3	4.16e+00	4.54	4.73e+06	2.59e+06	8.43e+06	1.53e+06	4.54e+06	9.59e+05	7.99e+06	7.89e+05	
8.4	1.93e+00	4.33	6.15e+06	2.56e+06	1.03e+07	1.52e+06	4.48e+06	9.40e+05	7.27e+06	7.63e+05	
8.5	6.45e-01	4.33	8.15e+06	2.57e+06	1.08e+07	1.47e+06	5.45e+06	9.15e+05	6.82e+06	7.28e+05	
8.6	3.24e-01	4.43	9.32e+06	2.51e+06	9.87e+06	1.39e+06	6.82e+06	8.77e+05	6.75e+06	6.89e+05	
8.7	4.61e-02	4.43	9.40e+06	2.36e+06	8.42e+06	1.29e+06	8.21e+06	8.32e+05	7.21e+06	6.50e+05	

TABLE A-7 (CONT'D)

Measured gamma-ray spectra behind bismuth shield, no background subtraction, continued (3/3).										
Energy (MeV)	Background		At power.		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$					
	0.00 w	Error	0.01 w	Error	0.02 w	Error	0.05 w	Error	0.1 w	Error
	$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{min}$		$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$							
8.8	5.52e-01	4.33	8.62e+06	2.18e+06	7.09e+06	1.20e+06	9.09e+06	7.85e+05	7.84e+06	6.13e+05
8.9	1.61e+00	4.24	8.12e+06	2.02e+06	6.09e+06	1.12e+06	9.12e+06	7.34e+05	8.24e+06	5.73e+05
9.0	2.67e+00	4.34	7.88e+06	1.86e+06	5.92e+06	1.06e+06	8.43e+06	6.74e+05	8.09e+06	5.26e+05
9.1	3.84e+00	4.49	7.66e+06	1.71e+06	5.97e+06	9.84e+05	7.17e+06	6.08e+05	7.22e+06	4.72e+05
9.2	4.19e+00	4.28	7.34e+06	1.58e+06	5.68e+06	8.99e+05	5.58e+06	5.41e+05	5.94e+06	4.19e+05
9.3	3.52e+00	3.90	6.35e+06	1.45e+06	5.26e+06	8.10e+05	4.26e+06	4.79e+05	4.57e+06	3.71e+05
9.4	3.04e+00	3.60	4.75e+06	1.29e+06	4.66e+06	7.19e+05	3.32e+06	4.25e+05	3.29e+06	3.27e+05
9.5	2.51e+00	3.28	3.03e+06	1.12e+06	3.79e+06	6.30e+05	2.60e+06	3.81e+05	2.30e+06	2.91e+05
9.6	1.99e+00	3.20	1.76e+06	9.86e+05	2.91e+06	5.58e+05	2.20e+06	3.47e+05	1.64e+06	2.61e+05
9.7	2.04e+00	3.34	9.25e+05	9.00e+05	2.16e+06	5.10e+05	1.89e+06	3.12e+05	1.20e+06	2.35e+05
9.8	1.79e+00	3.24	7.62e+05	8.48e+05	1.40e+06	4.59e+05	1.49e+06	2.76e+05	9.79e+05	2.15e+05
9.9	1.15e+00	2.88	1.04e+06	8.22e+05	7.95e+05	3.95e+05	1.15e+06	2.45e+05	8.66e+05	1.97e+05
10.0	7.78e-01	2.43	1.41e+06	8.09e+05	5.25e+05	3.50e+05	8.71e+05	2.22e+05	7.86e+05	1.80e+05
10.1	3.61e-01	2.17	1.60e+06	7.84e+05	4.21e+05	3.29e+05	5.98e+05	2.00e+05	7.05e+05	1.62e+05
10.2	2.01e-02	2.03	1.52e+06	7.27e+05	3.87e+05	3.26e+05	4.03e+05	1.81e+05	5.96e+05	1.45e+05
10.3	1.00e-02	1.95	1.22e+06	6.34e+05	4.88e+05	3.17e+05	3.12e+05	1.70e+05	4.60e+05	1.32e+05
10.4	1.00e-02	1.90	8.11e+05	5.31e+05	4.79e+05	2.88e+05	2.51e+05	1.62e+05	3.43e+05	1.19e+05
10.5	1.00e-02	1.78	4.24e+05	4.63e+05	3.81e+05	2.63e+05	1.70e+05	1.55e+05	2.19e+05	1.07e+05
10.6	1.00e-02	1.97	1.99e+05	4.32e+05	2.96e+05	2.53e+05	1.48e+05	1.51e+05	1.41e+05	9.66e+04
10.7	1.91e-01	2.20	4.84e+04	4.05e+05	1.66e+05	2.42e+05	1.34e+05	1.49e+05	9.93e+04	9.28e+04
10.8	3.02e-01	2.44	3.65e+04	3.77e+05	8.73e+04	2.29e+05	9.38e+04	1.40e+05	7.76e+04	9.35e+04
10.9	6.95e-01	2.86	2.66e+04	3.46e+05	7.40e+04	2.15e+05	7.28e+04	1.28e+05	6.89e+04	9.34e+04
11.0	9.66e-01	3.12	1.70e+04	3.02e+05	7.48e+04	2.07e+05	8.91e+04	1.20e+05	6.85e+04	9.09e+04
11.1	1.02e+00	3.27	1.00e-02	2.90e+05	6.08e+04	2.08e+05	8.11e+04	1.14e+05	6.28e+04	8.53e+04
11.2	1.08e+00	3.37	1.00e-02	3.02e+05	6.25e+04	2.10e+05	7.97e+04	1.17e+05	4.16e+04	7.89e+04
11.3	9.61e-01	3.12	1.00e-02	3.06e+05	6.40e+04	2.10e+05	1.05e+05	1.18e+05	3.02e+04	7.63e+04
11.4	6.93e-01	2.83	1.00e-02	2.84e+05	5.97e+04	1.99e+05	9.27e+04	1.14e+05	2.49e+04	7.38e+04
11.5	1.41e+00	2.80	5.58e+04	2.57e+05	4.35e+04	1.78e+05	9.73e+04	1.08e+05	2.14e+04	7.38e+04
11.6	1.97e+00	2.82	1.39e+05	2.83e+05	7.99e+04	1.65e+05	1.02e+05	9.43e+04	4.18e+04	6.84e+04
11.7	2.48e+00	2.98	2.97e+05	3.48e+05	1.32e+05	1.58e+05	9.24e+04	8.07e+04	7.09e+04	6.41e+04
11.8	9.25e+00	10.10	6.50e+05	1.15e+06	1.00e-02	3.84e+05	9.13e+04	1.68e+05	4.16e+04	1.50e+05
11.9	4.29e+00	5.75	6.29e+05	1.30e+06	4.50e+05	5.63e+05	9.04e+04	1.98e+05	1.78e+05	1.96e+05
12.0	1.00e-02	0.00	1.17e+06	1.07e+06	4.96e+05	4.14e+05	1.92e+05	1.66e+05	2.46e+05	1.51e+05
mr/hr			mr/kW hr							
4.03e+00		.0254	4.76e+05							
			4.44e+03							
			2.53e+05							
			2.37e+03							
			1.45e+05							
			1.42e+03							
			1.09e+05							
			1.12e+03							

TABLE A-8. MEASURED GAMMA-RAY SPECTRUM BEHIND BISMUTH SHIELD AFTER BACKGROUND SUBTRACTION

Measured gamma-ray spectra behind bismuth shield, background subtracted (1/3).									
Energy (MeV)	$\gamma/\text{cm}^2\cdot\text{MeV}\cdot\text{kWmin}$								
	0.01 w	Error	0.02 w	Error	0.05 w	Error	0.1 w	Error	Error
0.2	3.91e+09	6.48e+07	2.09e+09	3.24e+07	2.47e+09	1.49e+07	2.46e+09	1.49e+07	9.12e+06
0.3	2.76e+09	4.87e+07	1.30e+09	2.43e+07	1.54e+09	1.10e+07	1.55e+09	1.10e+07	6.65e+06
0.4	2.22e+09	4.19e+07	9.44e+08	2.08e+07	1.08e+09	9.54e+06	1.13e+09	9.54e+06	5.86e+06
0.5	2.19e+09	4.01e+07	1.17e+09	1.94e+07	1.37e+09	8.96e+06	1.39e+09	8.96e+06	5.57e+06
0.6	1.71e+09	4.03e+07	8.20e+08	1.86e+07	1.06e+09	8.34e+06	1.13e+09	8.34e+06	5.11e+06
0.7	1.48e+09	4.35e+07	8.74e+08	1.99e+07	1.03e+09	8.57e+06	1.07e+09	8.57e+06	5.16e+06
0.8	1.51e+09	6.49e+07	7.78e+08	3.07e+07	1.13e+09	1.31e+07	1.20e+09	1.31e+07	7.47e+06
0.9	2.99e+09	6.57e+07	3.20e+08	3.12e+07	8.23e+08	1.33e+07	1.01e+09	1.33e+07	7.59e+06
1.0	2.40e+09	4.13e+07	1.07e+09	1.89e+07	1.15e+09	8.33e+06	1.20e+09	8.33e+06	5.18e+06
1.1	1.19e+09	3.22e+07	8.38e+08	1.49e+07	8.93e+08	6.71e+06	9.13e+08	6.71e+06	4.28e+06
1.2	8.51e+08	3.64e+07	5.38e+08	1.67e+07	6.56e+08	7.24e+06	6.77e+08	7.24e+06	4.39e+06
1.3	8.02e+08	3.64e+07	2.06e+08	1.66e+07	3.82e+08	7.12e+06	4.44e+08	7.12e+06	4.27e+06
1.4	8.46e+08	3.03e+07	2.63e+08	1.39e+07	3.77e+08	6.09e+06	4.23e+08	6.09e+06	3.78e+06
1.5	7.48e+08	2.15e+07	3.72e+08	1.01e+07	4.27e+08	4.81e+06	4.78e+08	4.81e+06	3.29e+06
1.6	6.73e+08	1.45e+07	5.53e+08	7.36e+06	5.82e+08	4.00e+06	6.12e+08	4.00e+06	3.01e+06
1.7	6.78e+08	1.33e+07	6.12e+08	6.87e+06	6.26e+08	3.84e+06	6.30e+08	3.84e+06	2.91e+06
1.8	5.63e+08	1.21e+07	5.00e+08	6.28e+06	5.05e+08	3.54e+06	5.04e+08	3.54e+06	2.71e+06
1.9	4.01e+08	1.07e+07	3.64e+08	5.69e+06	3.67e+08	3.28e+06	3.69e+08	3.28e+06	2.55e+06
2.0	3.06e+08	1.04e+07	2.82e+08	5.55e+06	2.90e+08	3.25e+06	2.99e+08	3.25e+06	2.55e+06
2.1	2.91e+08	1.02e+07	3.72e+08	5.52e+06	2.93e+08	3.29e+06	3.12e+08	3.29e+06	2.60e+06
2.2	3.64e+08	1.02e+07	3.42e+08	5.58e+06	3.73e+08	3.36e+06	3.87e+08	3.36e+06	2.64e+06
2.3	4.08e+08	9.72e+06	3.85e+08	5.32e+06	3.98e+08	3.18e+06	3.96e+08	3.18e+06	2.49e+06
2.4	3.26e+08	8.86e+06	3.04e+08	4.85e+06	3.05e+08	2.88e+06	3.02e+08	2.88e+06	2.26e+06
2.5	2.31e+08	8.42e+06	2.20e+08	4.64e+06	2.34e+08	2.76e+06	2.39e+08	2.76e+06	2.17e+06
2.6	2.19e+08	8.42e+06	2.20e+08	4.64e+06	2.34e+08	2.76e+06	2.40e+08	2.76e+06	2.17e+06
2.7	2.30e+08	8.34e+06	2.25e+08	4.55e+06	2.31e+08	2.67e+06	2.33e+08	2.67e+06	2.09e+06
2.8	2.03e+08	7.99e+06	1.92e+08	4.33e+06	1.91e+08	2.52e+06	1.93e+08	2.52e+06	1.96e+06
2.9	1.56e+08	7.71e+06	1.46e+08	4.16e+06	1.47e+08	2.41e+06	1.51e+08	2.41e+06	1.88e+06
3.0	1.25e+08	7.62e+06	1.18e+08	4.11e+06	1.23e+08	2.37e+06	1.28e+08	2.37e+06	1.83e+06
3.1	1.10e+08	7.58e+06	1.07e+08	4.09e+06	1.14e+08	2.33e+06	1.17e+08	2.33e+06	1.79e+06
3.2	1.01e+08	7.67e+06	1.00e+08	4.12e+06	1.05e+08	2.31e+06	1.08e+08	2.31e+06	1.76e+06
3.3	9.33e+07	7.95e+06	8.82e+07	4.22e+06	9.29e+07	2.31e+06	9.62e+07	2.31e+06	1.74e+06
3.4	8.45e+07	8.31e+06	7.67e+07	4.39e+06	8.13e+07	2.34e+06	8.50e+07	2.34e+06	1.74e+06
3.5	7.64e+07	8.48e+06	6.80e+07	4.49e+06	7.39e+07	2.36e+06	7.56e+07	2.36e+06	1.73e+06
3.6	7.35e+07	8.43e+06	6.80e+07	4.46e+06	7.04e+07	2.33e+06	6.92e+07	2.33e+06	1.70e+06
3.7	7.27e+07	8.52e+06	6.05e+07	4.47e+06	6.58e+07	2.31e+06	6.46e+07	2.31e+06	1.68e+06
3.8	6.61e+07	9.03e+06	5.42e+07	4.70e+06	6.06e+07	2.37e+06	6.13e+07	2.37e+06	1.68e+06
3.9	5.86e+07	9.67e+06	5.17e+07	5.01e+06	5.81e+07	2.45e+06	5.90e+07	2.45e+06	1.69e+06
4.0	5.43e+07	9.74e+06	5.07e+07	5.05e+06	5.52e+07	2.45e+06	5.65e+07	2.45e+06	1.68e+06
4.1	4.92e+07	9.01e+06	5.06e+07	4.69e+06	5.04e+07	2.31e+06	5.40e+07	2.31e+06	1.61e+06
4.2	4.61e+07	8.32e+06	5.18e+07	4.34e+06	4.61e+07	2.18e+06	5.09e+07	2.18e+06	1.54e+06
4.3	4.75e+07	8.40e+06	5.12e+07	4.36e+06	4.23e+07	2.17e+06	4.68e+07	2.17e+06	1.52e+06
4.4	4.79e+07	8.78e+06	4.90e+07	4.53e+06	3.78e+07	2.21e+06	4.23e+07	2.21e+06	1.52e+06

TABLE A-8 (CONT'D)

Measured gamma-ray spectra behind bismuth shield, background subtracted, continued (2/3).									
Energy (MeV)	0.01 w			0.02 w			0.05 w		
		Error			Error			Error	
$\gamma/\text{cm}^2 \cdot \text{MeV} \cdot \text{kWmin}$									
4.5	4.65e+07	8.53e+06	4.59e+07	4.40e+06	3.42e+07	2.15e+06	3.76e+07	1.47e+06	
4.6	4.36e+07	7.45e+06	3.95e+07	3.86e+06	3.26e+07	1.97e+06	3.28e+07	1.40e+06	
4.7	4.18e+07	6.09e+06	3.24e+07	3.20e+06	3.34e+07	1.76e+06	2.96e+07	1.32e+06	
4.8	3.87e+07	5.16e+06	2.70e+07	2.77e+06	3.53e+07	1.64e+06	2.83e+07	1.27e+06	
4.9	3.55e+07	4.71e+06	2.29e+07	2.57e+06	3.60e+07	1.58e+06	2.72e+07	1.26e+06	
5.0	3.17e+07	4.51e+06	1.88e+07	2.50e+06	3.33e+07	1.55e+06	2.62e+07	1.24e+06	
5.1	2.73e+07	4.40e+06	1.82e+07	2.47e+06	2.72e+07	1.53e+06	2.61e+07	1.24e+06	
5.2	2.25e+07	4.38e+06	1.90e+07	2.46e+06	2.00e+07	1.53e+06	2.64e+07	1.24e+06	
5.3	2.02e+07	4.40e+06	2.21e+07	2.47e+06	1.41e+07	1.54e+06	2.57e+07	1.24e+06	
5.4	1.97e+07	4.44e+06	2.51e+07	2.51e+06	1.08e+07	1.56e+06	2.36e+07	1.25e+06	
5.5	1.96e+07	4.45e+06	2.71e+07	2.54e+06	1.10e+07	1.57e+06	2.04e+07	1.26e+06	
5.6	1.98e+07	4.50e+06	2.42e+07	2.55e+06	1.54e+07	1.58e+06	1.70e+07	1.27e+06	
5.7	2.22e+07	4.54e+06	2.02e+07	2.55e+06	2.19e+07	1.59e+06	1.46e+07	1.27e+06	
5.8	2.54e+07	4.54e+06	1.54e+07	2.54e+06	2.80e+07	1.60e+06	1.50e+07	1.28e+06	
5.9	2.67e+07	4.54e+06	1.43e+07	2.55e+06	3.14e+07	1.62e+06	1.82e+07	1.29e+06	
6.0	2.61e+07	4.60e+06	1.53e+07	2.55e+06	3.05e+07	1.63e+06	2.23e+07	1.30e+06	
6.1	2.34e+07	4.64e+06	1.93e+07	2.55e+06	2.44e+07	1.63e+06	2.54e+07	1.30e+06	
6.2	1.94e+07	4.63e+06	2.27e+07	2.54e+06	1.67e+07	1.60e+06	2.62e+07	1.29e+06	
6.3	1.46e+07	4.58e+06	2.57e+07	2.53e+06	1.04e+07	1.58e+06	2.45e+07	1.29e+06	
6.4	1.23e+07	4.50e+06	2.52e+07	2.51e+06	8.36e+06	1.57e+06	2.02e+07	1.28e+06	
6.5	1.36e+07	4.43e+06	2.20e+07	2.50e+06	9.56e+06	1.58e+06	1.50e+07	1.27e+06	
6.6	1.76e+07	4.41e+06	1.56e+07	2.50e+06	1.37e+07	1.59e+06	1.05e+07	1.27e+06	
6.7	2.21e+07	4.40e+06	9.83e+06	2.50e+06	1.76e+07	1.59e+06	8.06e+06	1.27e+06	
6.8	2.47e+07	4.40e+06	5.42e+06	2.50e+06	2.02e+07	1.57e+06	7.81e+06	1.27e+06	
6.9	2.39e+07	4.40e+06	4.74e+06	2.51e+06	2.00e+07	1.57e+06	1.01e+07	1.28e+06	
7.0	1.90e+07	4.38e+06	6.75e+06	2.52e+06	1.85e+07	1.57e+06	1.37e+07	1.28e+06	
7.1	1.35e+07	4.34e+06	1.16e+07	2.51e+06	1.54e+07	1.55e+06	1.74e+07	1.26e+06	
7.2	9.88e+06	4.24e+06	1.73e+07	2.46e+06	1.30e+07	1.51e+06	2.03e+07	1.22e+06	
7.3	9.95e+06	4.09e+06	2.28e+07	2.36e+06	1.20e+07	1.46e+06	2.24e+07	1.17e+06	
7.4	1.36e+07	3.93e+06	2.65e+07	2.23e+06	1.38e+07	1.39e+06	2.32e+07	1.12e+06	
7.5	2.04e+07	3.78e+06	2.80e+07	2.13e+06	1.73e+07	1.34e+06	2.31e+07	1.07e+06	
7.6	2.64e+07	3.65e+06	2.67e+07	2.05e+06	2.16e+07	1.30e+06	2.18e+07	1.03e+06	
7.7	2.94e+07	3.50e+06	2.30e+07	1.96e+06	2.39e+07	1.25e+06	1.94e+07	9.83e+05	
7.8	2.73e+07	3.35e+06	1.74e+07	1.87e+06	2.30e+07	1.19e+06	1.62e+07	9.34e+05	
7.9	2.21e+07	3.17e+06	1.13e+07	1.77e+06	1.93e+07	1.12e+06	1.32e+07	8.87e+05	
8.0	1.46e+07	3.00e+06	7.18e+06	1.71e+06	1.43e+07	1.06e+06	1.09e+07	8.47e+05	
8.1	8.37e+06	2.86e+06	5.88e+06	1.64e+06	9.41e+06	1.02e+06	9.45e+06	8.22e+05	
8.2	5.15e+06	2.73e+06	6.57e+06	1.58e+06	6.20e+06	9.86e+05	7.99e+06	8.07e+05	
8.3	4.73e+06	2.63e+06	8.43e+06	1.55e+06	4.54e+06	9.64e+05	8.58e+06	7.90e+05	
8.4	6.15e+06	2.60e+06	1.03e+07	1.54e+06	4.48e+06	9.44e+05	7.27e+06	7.64e+05	
8.5	8.14e+06	2.61e+06	1.08e+07	1.49e+06	5.45e+06	9.19e+05	6.82e+06	7.29e+05	
8.6	9.32e+06	2.55e+06	9.87e+06	1.41e+06	6.82e+06	8.82e+05	6.75e+06	6.90e+05	
8.7	9.40e+06	2.40e+06	8.42e+06	1.31e+06	8.21e+06	8.37e+05	7.20e+06	6.52e+05	

**Measured gamma-ray spectra behind bismuth shield, background subtracted, continued (3/3).**

 $\text{mm/hr}$





## REFERENCES

1. "Measurement of the Neutron Leakage from the U.S. Army Pulse Radiation Facility Fast Burst Reactor", Michael B. Stanka, Craig R. Heimbach, Mark A. Oliver in Proceedings of the Topical Meeting on Physics, Safety, and Applications of Pulse Reactors, Washington, D.C., 13 to 17 November 1994, pp 145 to 152.
2. "Measurement of the Neutron Leakage from the Aberdeen Pulse Radiation Facility (APRF) Fast Burst Reactor (FBR)", M.B. Stanka and C.R. Heimbach, CSTA-7690 (March 1995).
3. "The Development of a Monte Carlo Calculation for the Accurate Analysis of Photon, Electron and Positron Transport Problems in High-Z Media at Energies to 10 MeV and its Application to Small Bismuth Germanium Oxide Scintillation Detectors", James C. Wilson, a Thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy in the University of Toronto, 1986.
4. "Final Report of the Neutron Sensitivity of a Geiger Counter", Craig R. Heimbach, CSTA-7677, February 1995.
5. "Dosimetry of a Lightly Encapsulated  $^{252}\text{Cf}$  Source", L.J. Goodman, J.J. Coyne, J. Zoeteleif, J.J. Broerse, and J.C. McDonald, Rad. Prot. Dos., Vol. 4, No. 2, pp 91 to 96.
6. "Radiation Leakage from the Army Pulse Radiation Facility (APRF) Fast Reactor", D.C. Kaul and S.D. Egbert, SAIC-89/1423 (1989).
7. "PIN Diode and Neutron Spectrum Measurements at the Army Pulse Radiation Facility", M.A. Oliver, IEEE Trans. Nucl. Sci., Vol. 41, No. 6, pp 2132 to 2138 (1994).

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